. 36, No. 4
,000 to $2,500
to the amount
premium pay-
employes and
policy being
ur
ectory
SING
ory complete
CO. DAYTON, OHIO
T I N G
BOGGS
ntants
Accounting
1918.
k Bldg.
ana
PMAN
ARRESTERS
DE BY
ELECTRIC CO
OLIS, MINN.
rmatures
finish)
Gongs
EPAIR
ts
smitters
upply
IIO
ation 41
ype
l Wire
O.

Telephone Engineer

Published Monthly by TELEPHONE ENGINEER PUBLISHING COMPANY, 185 North Wabash Avenue

J. A. SMITH, President and Treasurer, 185 N. Wabash Ave., Chicago
D. WEINER, Secretary, 185 N. Wabash Ave., Chicago
C. L. JONES, Vice-President, Athens, Ohio
F. A. BOWDLE, Vice-President, Cerro Gordo, Illinois

E. D. GRAFF, Editor, 185 N. Wabash Ave., Chicago
HAROLD L. BEYER, Vice-President, Chicago

Eastern Representative, H. S. DURLAND, 63 Hinsdale Pl., Newark, N. J.

SUBSCRIPTIONS:—The subscription price of TELEPHONE ENGINEER is $2.00 a year in the United States, Cuba and Mexico; in Canada it is $3; in all other countries $4. Single copies, U. S. A., 20 cents.

Entered as second-class matter, at the post office at Morton, Ill., under the act of March 3, 1879.

Volume 36 MAY, 1932 No. 5

CONTENTS FOR THIS ISSUE

EDITORIALS 15-16
WHO IS TO BLAME?—GOOD PLAN FOR 1932

VACUUM TUBE THEORY AND PRACTICE... 17-18-36

NEW "REVENUE BUILDING PLAN FOR 1932" *By Ralph C. Reno* 19-20-21

THE TECHNICAL CLEARING HOUSE, *By B. C. Burden* 22-23

NEWS FROM THE FIELD 26

ANALYZE CURRENT PROBLEMS AT CONVENTION 27-28-29

LITTELFUSE GOES TO HOLLYWOOD 28-29

DEVELOPMENTS IN TELEPHONE TRANSMISSION, *By J. W. Keefe* 30-31-32-34-35-36

TELEPHONE NEWS FROM THE SOUTHWEST. 38

ANTS PUT FOUR PARTY LINE OUT OF SERVICE, *By Thos P. Carlyon* 38

TELEPHONE ACTIVITIES IN FOREIGN COUNTRIES 40

PERFECT OUTDOOR TELEPHONE 42

WITH MANUFACTURERS AND JOBBERS 45

Who Is To Blame? The widespread demand for reduction in the price of telephone service on the part of subscribers, brings to mind a subject discussed during telephone conventions for a number of years—namely—the desirability of keeping the public informed regarding the utility service for which they pay each month.

Telephone men generally conceded the advantages of this policy, but upon returning to their homes following the conventions, promptly forgot it.

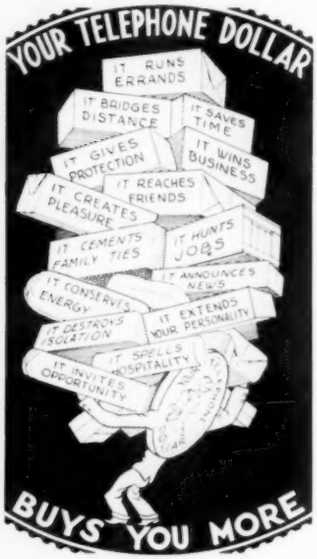
Of course hindsight is always better than foresight, but it is particularly unfortunate that some definite action was not taken along these lines when the idea first suggested itself to telephone men, considering present conditions in this industry.

Especially is this true with regard to the smaller exchanges, for in most cases it is the farmer who is complaining of telephone rates, threatening boycott, and otherwise criticizing the telephone company for not reducing the cost of service to subscribers.

We cannot help wondering whether things might not have been different had telephone companies begun years ago to educate their subscribers as to the many costs and responsibilities entailed in pro-

viding them with the telephone service which they so soon accepted as their due and for which they have paid so little in proportion.

The subscriber rarely considers the hazards and inconveniences as well as expense involved in keeping up the service at all times and under all conditions. During a heavy snow or sleet storm the subscriber does not know that in all probability men are out in that storm repairing broken lines, so that if there is sickness in the home of a subscriber, the physician can be called quickly and easily. The subscriber does not consider that many an operation is required to turn detective in order to seek out a person for whom long distance is calling; yet the company receives no compensation for this trouble other than the long distance charge for the call itself. Telephone operators and employees have been the heros of many fires, floods, earthquakes, hurricanes and other disasters. Frequently their heroic actions have saved many lives and many dollars worth of property. Yet for this service there is no charge. These services continue, regardless of whether the company has many subscribers, or only a few, and regardless of whether general business conditions are very good or very bad.



Courtesy "Cross Talk"

This small illustration tells volumes. It could be used as an advertisement or included with the statement when mailed.

Neither does the subscriber know that the equipment which provides this service must be kept in good condition, and because of wear and tear, must be replaced at certain intervals. Both the original cost, as well as the upkeep cost of this equipment is an enormous expense to telephone companies, and this also continues in bad times as well as good times, for a few subscribers, as well as for many subscribers.

If each subscriber does not know all these facts about his, and every other telephone company, he should know them, and the telephone company should see to it that he is so informed. In the light of these facts, the small charge made to each subscriber for the wealth of service provided by the telephone company, seems pitifully small.

Local newspaper advertisements, publicity stories in local newspapers (editors have always been found eager to cooperate in giving telephone companies constructive publicity if it is provided by the telephone company) and informative literature mailed to subscribers, either alone, or with the subscriber's statement, are a few of the methods of disseminating this telephone information. The cost of a small advertisement similar to the illustration shown here would not be prohibitive, either as a newspaper advertisement, or mailed with the statement. A series of such advertisements could tell the telephone company's story in an entertaining fashion, and serve as a constant reminder of the value of telephone service to the subscriber.

Good Plan For 1932 A definite need to sell service has been felt throughout the telephone industry, the executives of which previously had followed a simpler policy of taking orders which came in without solicitation.

To date those in the industry have been floundering about in an attempt to carry out sales and advertising programs, a feat for which they were totally unprepared and entirely inexperienced. These campaigns have succeeded in varying degrees.

The belief on the part of several operating companies that more expert direction was required to make such campaigns achieve maximum results, has culminated in a crystallization of the industry's need, namely the "Revenue Builders' Plan for 1932."

This Plan was drawn up by an advertising agency in Rochester, N. Y., after receiving numerous requests for advice on such a campaign by operating companies over the country. It is based on facts uncovered during a thorough research and study of conditions of the telephone industry, conducted over the last twelve months. An outline of the campaign is given in this issue of TELEPHONE ENGINEER.

The Plan is believed to cover every possible phase of conducting an advertising and sales campaign to sell telephone service, in scientific fashion. Its tone is local rather than national, and it is adaptable to the smallest as well as the largest telephone companies. It is easy to follow and should greatly simplify the work of telephone executives in planning and carrying out a successful campaign for increased telephone sales.

Those desiring additional information on this splendid aid to telephone companies, the "Revenue Builders' Plan for 1932," should write Jack Knabb, c/o Lyddon, Hanford, and Frohman, Inc., 11 James Street, Rochester, N. Y.

VACUUM TUBE THEORY AND PRACTICE

SUBJECT: OSCILLATORS

General

The term "oscillator" as used in the electrical industry refers to any device, other than the regular commercial alternators, used for generating either low or high frequency alternating current.

Oscillators accomplish the same purpose as alternators; i. e., generate alternating current, but because of the unique and diverse principles of operation employed it is desirable that they be separately identified by the term "oscillator". The alternating current output of an oscillator is referred to by many writers as "oscillations." It is preferable, however, to think and speak of the output of oscillators as either low or high frequency alternating current, as the term "oscillation" is apt to be confusing.

Oscillators are exceptionally useful in the telephone and radio fields, and find use both in the basic operation of many circuits and in connection with transmission measurements on communication circuits and equipment.

Variable and Fixed Frequency Oscillators

Oscillators may be separated into two classes; viz, (1) variable frequency oscillators, (2) fixed frequency oscillators.

The variable frequency oscillators in common use in communication work are so arranged that any frequency between 50 and 50,000 cycles can be obtained by means of variable controls. Variable frequency oscillators for use in connection with radio set testing are available covering the broadcast range of 550 to 1500 K.C.

Laboratories are equipped with groups of oscillators which permit making measurements on practically any frequency in the audio or radio frequency range.

EDITOR'S NOTE:—*The series of articles on Sound Projection Practices will be resumed in the June issue.*

An example of the use of the oscillator in connection with the operation of a piece of equipment is in the modern superhetrodyne radio which depends on a variable frequency oscillator for proper operation, and whenever the tuning dial of the radio is changed the frequency of this oscillator is varied.

Fixed frequency oscillators used in the telephone field for transmission measuring purposes are generally designed to have a 1,000 cycle output, as this frequency represents the average voice frequency.

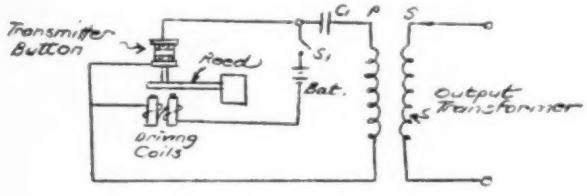


Fig. 1. Tuned reed type oscillator.

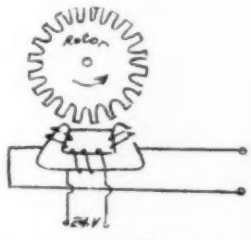


Fig. 2. Inductor type oscillator.

In connection with carrier systems, fixed frequency oscillators are utilized with the frequency of the oscillators ranging from 6,000 to 30,000 cycles, depending on the type system involved.

Types of Oscillators

There are a number of different types of oscillators but only the most important ones will be discussed in this article; viz, (1) the tuned reed type, (2) the inductor type, (3) the vacuum tube type.

Of the above types of oscillators, the vacuum tube type is the most important and useful. The tuned reed oscillator has considerable application in connection with transmission testing, however, it can only be used when single frequency tests are made. The inductor type, while a satisfactory type for transmission testing, is too bulky and expensive to find general application.

Theory of the Tuned Reed Oscillator

The tuned reed oscillator consists essentially of a reed having a natural period of the desired frequency, a transmitter electrode assembly mechanically coupled to the tuned reed, an electromagnetic coil arrangement to drive the reed, and an output transformer.

Fig. 1 shows schematically the circuit of a reed type oscillator.

The operation of this type oscillator is as follows: When the switch (S1) is closed, the reed is attracted toward the pole pieces of the electro magnetic coils. This causes the pressure between the two electrodes in the transmitter button to be reduced and the resistance of the button automatically increases. The button being in series with the battery and electromagnetic coils, the increased resistance causes the reed to fall back thereby again lowering the resistance of the carbon button. The lowered resistance of the button results in an increased current flow through the coils and the reed is attracted to the pole pieces. This cycle of events is repeated over and over at a frequency determined by the natural period of the reed. The condenser (C_1) in series with the primary winding (P) being connected across the transmitter button will charge and discharge in accordance with the voltage changes across the button. The varying current flowing thru the primary winding will set up an alternating current across the secondary of the output transformer which may be utilized for any desired purpose requiring a constant frequency.

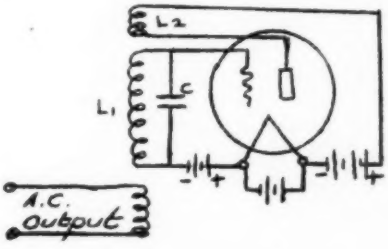


Fig. 3. Simple vacuum tube oscillator.

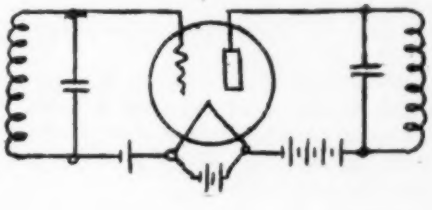


Fig. 4. Tuned plate-tuned grid type oscillator.

The output wave form of a tuned reed oscillator contains fairly strong harmonics hence it is customary to employ some form of filter in the output circuit to suppress the harmonics present.

On a well designed oscillator, such as the Western Electric or General Radio, the second or third harmonic should not exceed 5% of the total output voltage.

The Western Electric tuned reed oscillator has an internal impedance of

approximately 600 ohms. The General Radio type 213-B oscillator has a tapped secondary with a low, medium and high impedance tap. The impedance presented at the terminals of each respective tap is low (100w), medium (500), high (4000).

The tuned reed 1000 cycle oscillator may be used for measuring line or equipment loss, for measuring amplifier gain, and for many other similar applications.

The Inductor Type Oscillator

The inductor type oscillator consists of a constant speed motor having a laminated toothed rotor which revolves between two pole pieces of an electromagnet. The electromagnet is polarized from a direct current source.

When the rotor is revolving the magnetic reluctance of the path between the pole pieces is varied due to the teeth on the rotor. This variation in magnetic flux induces an alternating current in the output winding. The output frequency is determined by the number of teeth in the rotor and the speed at which it revolves. The frequency can be computed by the following equation.

$$F = \frac{RPM}{60} \times \text{No. teeth.}$$

Where: F = Frequency.
RPM = Revolutions per minute.

With this type oscillator it is essential that the teeth and pole pieces be properly shaped, otherwise harmonics of larger magnitude may be present in the output.

Oscillators of this type are used by the Bell System to some extent in transmission testing. The motors are usually designed to operate from the central office batteries hence can be used only in common battery offices. Fig. 2 shows schematically the component parts of an inductor type oscillator.

Vacuum Tube Oscillator

The most popular oscillator in use today is the vacuum tube type. By means of relatively simple circuits and equipment vacuum tube oscillators can be constructed with output frequencies from a few cycles per second up to millions of cycles per second.

A vacuum tube oscillator operates by virtue of the fact that it is an amplifying device and if energy in the output circuit is fed back to the input circuit this energy will be amplified and will again appear in the plate circuit. This

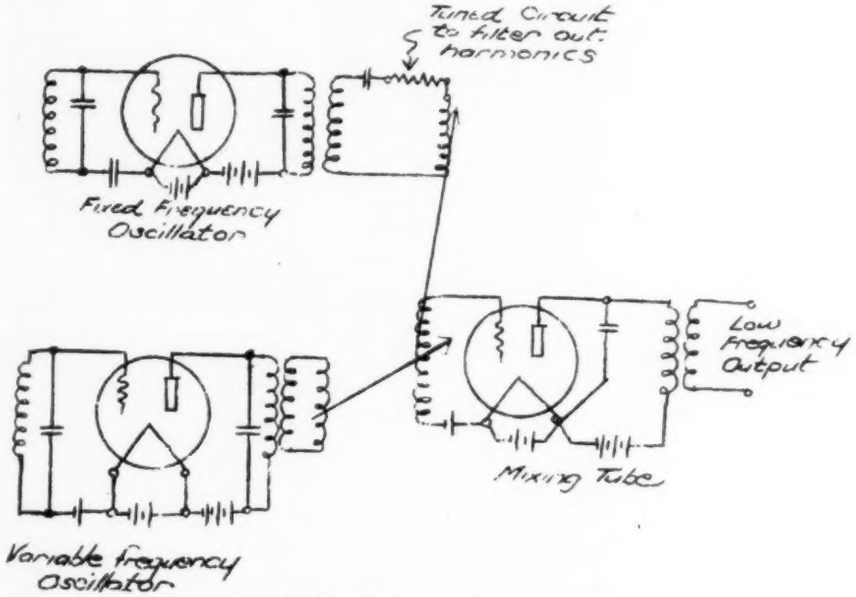


Fig. 5. Beat frequency type oscillator.

cycle of events will continue indefinitely and at a frequency determined by the inductance and capacity present in the grid or plate circuit.

Fig. 3 shows the circuit of one of the simplest types of vacuum tube oscillator circuits.

It will be observed in this arrangement that the grid circuit consists of an inductance (L) and capacity (C) which are tuned to the desired frequency, and that the plate is inductively coupled to the grid through inductance (L_2) circuit.

The grid is biased so that the tube operates over the straight portion of its characteristic curve.

The theory of operation of this oscillating circuit is as follows: When the battery switch (S_1) is closed the filament begins to throw off electrons which are attracted to the plate and flows through the plate winding (P_1) back to the plate battery. This surge of current in the plate coil induces a voltage across the grid inductance (L_1).

Energy thus surges back and forth between plate and grid circuits at a rate determined by the natural period of the tuned circuit consisting of the inductance (L_1 and condenser (C_1).

The current surges in the grid and plate windings set up by induction, are alternating current potential across the output winding which may be utilized for any desired purpose.

The frequency is reduced as either the inductance or capacity in the tuned circuit is made larger, and increases as they are made smaller.

There are a number of different types of vacuum tube oscillator circuits, however all depend on some method, either electrostatic or electromagnetic, of feeding energy from plate back to the grid circuit.

Fig. 4 illustrates another type of vacuum tube oscillator circuit which is known as the "tuned plate-tuned grid circuit." This circuit requires that both the plate and grid circuits be tuned and the energy from the plate circuit is fed back to the grid circuit thru the capacity between the plate and grid.

In connection with low frequency oscillators the internal capacity between plate and grid must be supplemented by an external condenser in order to provide sufficient feedback voltage to produce oscillation.

The principal difference between low and high frequency oscillators is in the size of inductances and condensers used in the grid and plate circuits. High frequency oscillators are much easier to build than low frequency oscillators as the inductance and capacity values are relatively small.

Variable frequency oscillators, with frequencies falling in the "radio" end of the spectrum are very simple in construction as they can utilize ordinary variable multi-plate air condensers as the frequency control. Variable frequency oscillators for use at audio frequencies, however, are much more complicated as a variable condenser designed to tune the grid or plate circuit of an oscillator operating on frequencies in the audio (voice) range would be enormous in size and very impractical.

Variable frequency oscillators for use in the region below 50,000 cycles therefore must resort to another principle of operation which is described in the next paragraph.

Theory of Beat Frequency Oscillators

The type of variable frequency oscillator most suitable for use on the lower frequencies is known as the "beat frequency type". A beat frequency oscillator consists essentially of two high frequency oscillators, one having a fixed

(Continued on page 36.)

New "Revenue Builders' Plan for 1932"

Ralph C. Reno Describes a Complete Sales Campaign Available to Independent Telephone Managers, Designed to Educate Subscribers and Non-Subscribers to the Value of the Telephone and So to Increase the Sale of Telephone Service

"The telephone industry is now 50 years old and we are only beginning to sell our product. In the past we've acted as order takers to welcome those who came to us with a contract in their hands.

"We decided it was about time for everybody in our organization from the top down, to take off their coats, and to dig in. If the business refused to come to us in the required amount, there remained only one thing to do, for us to go out after new *business* and to somehow bring it in."

The above statement was made recently by a prominent Ohio telephone executive following an aggressive employee selling campaign that resulted in a net gain in telephones for two months, following heavy losses during the several months previous.

Must Sell Service Instead of Just "Taking Orders"

This executive did what many others are doing now, realizing that they must go out and *sell* their service instead of continuing to be just order takers.

Many telephone managements have awakened to the fact they are losin stations so rapidly that if it continues it will seriously threaten their business.

Telephone service is one item that the public cannot afford to be without. Operating companies have one of the greatest products on the market to sell and yet they have stood by and watched cancellations come in to the point where it is alarming, without making much effort to resell the subscriber cancelling his service or go out and get new customers.

Dr. Crane Sums Up Situation

The late Dr. Frank Crane, in my opinion, summed up the value of the wonderful product of telephone companies in a short article which reads:

"No man starts in business today without a telephone. A man who hasn't a telephone isn't in business! A man who fails to make the maximum use of his telephone doesn't stay in business.

"It is the telephone more than any one thing which enables him to serve his customers.

"In the same way, no man sets up a household nowadays without installing a telephone. Whether his wife is left alone in the suburbs with the children, or isolated in a farmhouse far from neighbors, or shut up in an apartment in the city, every man wants his wife within speedy reach of assistance in case of need.

"The telephone is a burglar alarm, a protection against accidents, with the doctor at the other end, and at the same time one of the best forms of fire insurance. But, better than its business uses—better than its household uses—is its quiet, continuous influence, for neighborliness."

Necessary to Educate Public

The only thing that will stop present cancellations of existing telephone service is to educate the public in the absolute necessity of the telephone and show subscribers and prospective customers why they can't do without it.

If an education program of this type had been carried on during past years, the rate of cancellations would no doub be lower today.

Now the question of how to condu an educational program arises.

Judging by reports from major telephone interests, employee sales campaigns, in which employees find the own prospects and do the actual selling, is one of the most efficient, if not the most efficient, methods for keeping present subscribers and for obtaining ne ones.

Without a doubt no group of persons

Why mothers turn GRAY!
LAUGH as we do at children's pranks, there are times when they upset the nerves of the entire household. They often take the law in their own hands and then trouble, real or imaginary, appears. Baby, knowing mother will interfere, locks the bathroom door, and has the time of its life splashing in the filled bathtub.
Mother promptly pictures a flooded house, or baby falling into the tub. Other mothers faced with a like situation have quickly secured help from police or fire department—by calling for advice and help on the telephone. A child's health and safety can't be measured in dollars and cents. The telephone is added home protection that costs less than 10 cents a day.
Call our Business Office for new service or an extension telephone. No charge on any pay station.
TELEPHONE COMPANY NAME HERE

One of the newspaper ads in the "Revenue Builders' Plan for 1932".

is better qualified to tell the subscriber or prospect the value of the telephone than those who are spending every minute of their working time in the telephone plant.

Employees Eager to Serve Company

Companies conducting this type of campaign find their employees grasp the opportunity to help their company and to improve its service to the public and find they will lose no time in digging up prospects and selling them.

Employee campaigns are not only applicable to larger companies, but the smallest telephone companies can carry on successful campaigns by enlisting everyone connected with the company including directors, the management, stockholders and employees.

While telephone companies have had offered them plans for many employee campaigns involving the use of advertising or a few booklets, there has been a marked lack of completeness and coordination in the plans submitted.

An employee campaign will not produce maximum results unless the soliciting and employees' work is supplemented or followed up by well-planned, well-designed, compelling and persuasive advertising and sales promotion materials.

Complete and Thorough Campaign

Perhaps the most complete and thorough campaign that ever has been offered to telephone companies is the "Revenue Builders' Plan for 1932" designed by Jack Knabb, telephone advertising specialist of Lyddon, Hanford and Frohman, Inc., Rochester, N. Y., advertising and sales counselors for Stromberg-Carlson Telephone Manufacturing company and Rochester (N. Y.) Telephone corporation.

Your wife runs every race . . .
BEDROOM TO TELEPHONE
50-YARD DASH
KITCHEN TO TELEPHONE
25-YARD DASH
LAUNDRY TO TELEPHONE
50-YARD DASH
BATHROOM TO TELEPHONE
50-YARD DASH
(OBSTACLE RACE)
. . . but there's no applause from the grandstand!
The telephone bell is like a starting gun to your wife, who sprints from every room in the house a dozen times daily at its ring.
In grueling obstacle races she dashes from bedroom or bathroom—up and down stairs—to catch the receiver in time.
Order an extension telephone for the upstairs and keep her fresh and happy. Besides saving time and steps, it insures privacy, convenience and safety in an emergency
It costs but a few cents a day
Call our Business Office for new service or an extension telephone
No charge on any pay station.
TELEPHONE COMPANY NAME HERE

Another newspaper ad in the "Revenue Builders' Plan for 1932".

At the request of several operating companies this agency carried on a thorough research in the problems of the independent telephone industry before they attempted to build a plan which, if properly administered, would result in increased revenue for operating companies. The result of its effort is the "Revenue Builders' Plan".

This plan contains every conceivable unit that goes to make up an ideal campaign.

Each piece of advertising material, each unit of the plan has been designed for a specific purpose. Every effort has been made to eliminate a "national" atmosphere, and retain individual color as much as possible.

Realizing that the average telephone company executive is too occupied with the many details of his position, the "Revenue Builders' Plan" has been arranged to furnish him with everything he needs to carry out a revenue builders campaign.

When he decides to conduct a campaign—illustrations and text for newspaper advertisements, letters to prospects or enclosures in subscribers' bills—he can have any or all of these laid on his desk and know that he will not have to devote valuable time to their preparation.

Campaign Material All-Inclusive

Included in the campaign material is:

1. Revenue Builders' Campaign
   a. Instruction manual for campaign manager.
   b. Employees' Handbook.
   c. Prospect Cards.
   d. Service applications.
   e. Bulletin Heads.
   f. Design for scoreboard.
2. Newspaper Advertising.
   a. 26 advertisements in two sizes for 6 months' or one year's schedule.
   b. Series of newspaper articles for publication in news columns of local papers.
3. Direct Mail Materials.
   a. 3 types illustrated letters for picked prospects.
   b. 6 or 12 different folders for prospects or subscribers.
   c. 2 types of blotters for enclosures or general distribution.
4. Display materials.
   a. 2 types of eye-catching counter cards for offices.
   b. 2 types of display cards for street cars, windows or walls.
   c. 2 types of window trim designs.

The theme of all the advertising materials is human interest and "protection". Advertisements, blotters, circulars, folders and display cards graphically portray the dangers of fire, sickness and burglary and each illustration and each piece of copy brings out how a telephone gives protection, safety and security—the most economical insurance on the market.

In this way human interest is emphasized. These ads, circulars, cards, etc., appeal to women which is the best way to get telephones in homes. As in all other businesses, telephone advertising must have human interest appeal if it is to sell telephone service.

Campaign Easy to Follow

With the Revenue Builders" Campaign manager's manual before him, any executive can organize his campaign step-by-step. It is a simplified direct list of details or instructions, so compiled, that following it becomes automatic, and time

and energy of the executive are conserved.

Details covered in the manager's campaign material are points covering duration of campaign, objective of campaign, setting of quotas, methods of determining quotas for campaign, types of service to be sold, compensations, if any team awards are to be made, individual awards, organization, personnel divisions, teams, rules, meetings, reports, bulletins, scoreboard prospects—where and how to get them pre-call literature, newspaper schedule, employees handbook, training employees, how to sell service, methods of canvassing and rates.

All circulars, blotters, street car, bus and counter display cards are in two colors.

In designing this campaign, Lyddon, Hanford and Frohman has given telephone companies a sales campaign that will compare with those carried on successfully by other lines of business.

It was prepared with the idea in mind to help telephone companies to push their business with judicious advertising and honest energetic salesmanship.

One of the form letters of the "Revenue Builders' Plan for 1932" designed to be sent to subscribers and prospects. These are four-page letters in three colors. The telephone as protection against sickness and death is the theme of the above letter.

Above: Three of the attractive and appealing four-page circulars included in the "Revenue Builders' Plan for 1932". Below: Two of the blotters in this plan designed for distribution over the counter or for enclosures. Each of these pieces are in two colors.

Equally Suited to Large and Small Companies

One of the features of the plan is that it can be used by small operating companies as well as large ones. The amount of advertising and sales promotion materials used by a company depends on the number of subscribers and the number of prospects.

It can be said without doubt that the "Revenue Builders Plan for 1932" is one of the most constructive helps ever given to independent telephone companies. If managers are planning to conduct campaigns, it would be well worth their while to investigate this new and most outstanding plan.

All inquiries concerning the "Revenue Builders' Plan for 1932" should be addressed to Jack Knabb, Lyddon, Hanford and Frohman, Inc., 11 James Street, Rochester, N. Y.

Directors of the Bell Telephone company have approved appropriations totaling $1,202,646, for new construction and service betterments throughout the state of Pennsylvania, in the near future. This brought the total set aside by the Bell company for these purposes thus far this year to $2,992,289.

Of the new appropriations, $802,470 will be used for plant extensions and improvements in Philadelphia alone. The appropriation for eastern Pennsylvania was $33,470.

The Sound Engineering corporation of New York, N. Y., has announced an automatic answering telephone, employing the device used for making personal phonograph records. When the telephone rings an automatic arm takes the receiver off the hook and a tiny record starts to spin. The message is recorded thereon.

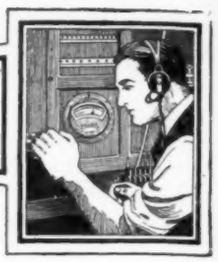
The Central West Public Service company, owners of the Iowa-Illinois Telephone company, have announced that the district office of the Iowa-Illinois division, covering 20 towns, will be moved from Burlington, Iowa, to New London, Iowa.

W. S. VIVIAN JOINS GRIGSBY-GRUNOW COMPANY

W. S. Vivian, well known to most of the telephone fraternity, but who has been with the Middle West Utilities company until recently, has joined the forces of the Grigsby-Grunow company and will call upon public utilities in the interest of Majestic refrigerators, manufactured by the above concern.

THE TECHNICAL CLEARING HOUSE

B. C. BURDEN, Editor



Visual Signalling Arrangement

Q.—Is there any simple arrangement for providing a visual signal at subscribers stations where several central office trunks are in use, so that the confusion resulting where several ringers are located close together will be eliminated?

A.—An excellent arrangement for providing a visual signal for use in installations where several bell boxes are located close together and it is difficult

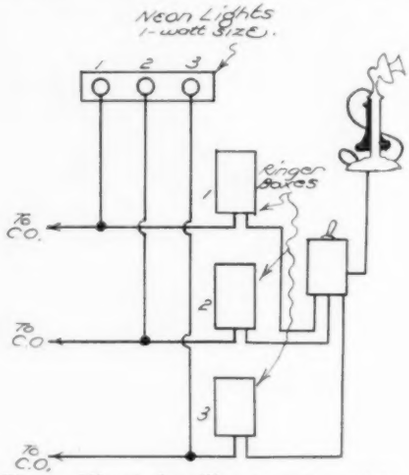


Fig. 1. Visual signalling arrangement to permit distinguishing signals on several telephones.

to determine which bell is being operated, is shown in figure 1. This arrangement involves merely bridging a one watt neon light across the line. The lamp will light up on incoming ringing current. The impedance of the lamp is high at voice frequencies hence the transmission loss is quite small, and it draws very little ringing current from the line therefore does not interfere with the normal operation of the ringer. Neon lamps in ½, 1 and 2 watt sizes are now available with standard bases.

Transmitter Frequency Response

Q.—Why is the frequency response of the ordinary single button transmitter used on telephone subsets much inferior to that of the double button transmitter (commonly called microphone) used in public address and broadcasting work?

A.—The more accurate frequency response of the two button microphone, as compared to the single button telephone transmitter, is due primarily to the fact that most high grade two button microphones utilize a stretched diaphragm. The diaphragm is stretched so as to be resonant at a frequency somewhat higher than the upper frequency which the microphone is designed to pass, thus the diaphragm movement for a given sound input will be fairly uniform over the desired frequency range. The diaphragm of the ordinary telephone transmitter being unstretched has a natural period (frequency) of approximately 1000 cycles hence will give the greatest resistance variation for a given sound input at this resonant frequency and the response will diminish at either higher or lower frequencies.

The two button microphone also offers considerable improvement in intelligibility due to the differential action of the two buttons. That is distortion in one button will be cancelled by equal and opposite distortion in the other button.

New Pole Classification System

Q.—What are the basic differences between the new method of designating pole classes which was recently adopted (1931) by the American Standards Association and the old alphabetical method.

A.—The new method of designating pole classes which was adopted by the American Standards Association in 1931 is based on the use of a numerical rather than an alphabetical designation for the

Table No. 2—Minimum Dimensions for Northern White Cedar Poles (Numerical classification)

Pole class	1	2	3	4	5	6	7	8	9	10
Mininmum top cir. in inches	27	25	23	21	19	17	15	18	15	12

Length of pole in feet	Setting Depth	Minimum circumference at a point 6 feet from the butt							
16	3½	....	....	....	....	26.0	24.0	22.0	
18	3½	....	....	32.5	30.0	28.0	25.5	23.5	
20	4	39.5	37.0	34.0	31.5	29.0	27.0	25.0	
22	4	41.0	38.5	36.0	33.0	30.5	28.0	26.0	
25	5	43.5	41.0	38.0	35.5	32.5	30.0	28.0	Top dimensions
30	5½	47.5	44.5	41.5	38.5	35.5	33.0	30.5	only specified
35	6	50.5	47.5	44.0	41.0	38.0	35.0	32.5	for class 8, 9, 10
40	6	53.5	50.0	46.5	43.5	40.0	37.0	....	
45	6½	56.0	52.5	49.0	45.5	42.0	....	....	
50	7	58.5	55.0	51.5	47.5	44.0	....	....	
55	7½	61.0	57.5	53.5	49.5	46.0	....	....	
60	8	63.5	59.5	55.5	51.5	....	....	....	

Table No. 3—Minimum Dimensions for Creosoted Southern Yellow Pine

Pole class	1	2	3	4	5	6	7	8	9	10
Mininmum top cir. in inches	27	25	23	21	19	17	15	18	15	12

Length of pole in feet	Setting Depth	Minimum circumference at a point 6 feet from the butt							
16	3½	....	....	....	....	21.5	19.5	18.0	
18	3½	....	....	26.5	24.5	22.5	21.0	19.0	
20	4	31.5	29.5	27.5	25.5	23.5	22.0	20.0	
22	4	33.0	31.0	29.0	26.5	24.5	23.0	21.0	
25	5	34.5	32.5	30.0	28.0	26.0	24.0	22.0	Top dimensions
30	5½	37.5	35.0	32.5	30.0	28.0	26.0	24.0	only specified
35	6	40.0	37.5	35.0	32.0	30.0	27.5	25.5	for class 8, 9, 10
40	6	42.0	39.5	37.0	34.0	31.5	29.0	27.0	
45	6½	44.0	41.5	38.5	36.0	33.0	30.5	28.5	
50	7	46.0	43.0	40.0	37.5	34.5	32.0	29.5	
55	7½	47.5	44.5	41.5	39.0	36.0	33.5	....	
60	8	49.5	46.0	43.0	40.0	37.0	34.5	....	

various classes of poles commonly used for telephone and power work.

The purpose of changing the method of designating standard pole sizes was to obtain a more uniform classification and one which would permit directly comparing poles of the same class and length but of different timber. Under the numerical classification method *all poles of the same class and length will have approximately equivalent breaking strengths.* This is a considerable advantage as it permits a direct comparison of the economy of various timbers to produce a given strength line.

The numerical system is based on seven classes numbering from 1 to 10 with breaking loads as shown in the following table.

Table No. 1—Breaking Load of Numerical Pole Classes

Pole Class	*Breaking Load (Lbs.)*
1	4500
2	3700
3	3000
4	2400
5	1900
6	1500
7	1200
8	None specified
9	None specified
10	None specified

All pole classes with the exception of 8, 9, and 10 are specified in terms of circumference 6 feet from the butt and circumference at the top. Classes 8, 9, and 10 are specified in minimum top dimensions only, hence a breaking load is not stipulated for these three classes.

The minimum top circumferences specified under the numerical classification are the same for all poles of the same class regardless of specie. That is, a class 1 Cedar would have the same minimum top circumference as a class 1 pine.

Tables two and three give the standard dimensions of poles under the numerical classification, as set up by the American Standard Association for Northern White Cedar, and Southern Yellow Pine.

PRESIDENT GALLON'S ADDRESS BEFORE WISCONSIN CONVENTION

An appeal for conservatism and simplified practices in the telephone industry was made before members of the Wisconsin Telephone Association at its annual convention, by President Walter Gallon in his annual address. President Gallon is manager of the Antigo Telephone company, Antigo, Wisc.

"Telephone management must remain in the hands of men who have been schooled in the arts of the game, rather than in the hands of would-be financial wizards who attempt to operate telephone companies by a system of absentee landlordism with immense monetary gain as their goal," said President Gallon.

"There never was big money in the operating end of the telephone business and there never will be." he continued. "But there has always been a fair return on investment and a decent living for those who managed their business conservatively."

President Gallon said in the last ten years the telephone industry has witnessed a gradual drifting away from conservative methods of doing business.

Impractical Theories

"Today we find those with depleted purses crying to the government to help them out of the mess they have gotten us into. The mob voters put men in office after listening to political promises. Theories by the thousands come into the picture. But few of the theorists have had any practical experience in handling these stupendous issues.

"In the meantime," continued President Gallon," the practical men are up against it because men with political intent have listened to the mob, and by the time the practical men get hold of the thing, the damage has been done. And those who have put their savings into the business have to suffer immense losses.

"Some of us have had to go to our bankers to get money to meet this inflated condition," President Gallon said. "Fear of what our financial backers would do to us has pushed us into the realms of super-salesmanship. And I believe implicitly that super-salesmanship is the cause of our troubles today.

"Now we are faced with the necessity of getting back to the real, fundamental soundness of the business. People of our country must be brought back to a sound sense of living, and the idiotic frills that the populace has taken will have to be discarded. We must learn to live within our purse and not in the future."

Telephone Industry Will Stand Test

President Gallon said the telephone industry will stand the test like no other industry will and the conservatively managed organization will meet the present situation.

"I firmly believe modern conditions make it impossible to get along without the telephone," he said. "So why should we let the condition upon us at this time lead us into fits of despair? The fundamental soundness of our business cannot be disturbed. The telephone industry, in my estimation, will be one of the leaders to bring this country back to the sanity that belongs to it." President Gallon said the era of super-prosperity just passed, was bound to stop because it was far from normal.

"It is unfortunate," he said, "that many innocent persons will suffer considerable losses due to the financially minded persons who attempted telephone operations.

"But those who have been honest in their convictions and have stuck to their guns along conservative lines, are bound to win."

Complicated Accounting

President Gallon criticized the complicated accounting systems which have been built into telephone structures, which, he said, were almost beyond the understanding of the operating head.

"Anybody with common sense knows, in order to save our structure, we must have a depreciation account, a construction account, and a repair account, but why the major accounts should be classified into hundreds of minor accounts, is beyond me," he said. "Elaborate systems lead us into legal complications, and the door is opened for a never ending battle which adds frightful costs to management."

President Gallon also stated as his belief that the Federal Government should be divorced from intra-state movements.

"By far the majority of us have nothing to do with outside of state movements. This duplication of regulation, in my estimation, is entirely unnecessary, and I believe if the Interstate Commerce commission were to give up the regulation of intra-state properties, a great saving could be made in their department."

He recommended the passing of a resolution to the effect that a movement be started by utility commissions of the various states to have the intra-state companies separated from Federal regulations, to be sent to the Public Service Commission of Wisconsin.

PENNSYLVANIA COMPANY ERECTS NEW BUILDING

The Denver & Ephrata Telephone & Telegraph company, operating properties in Lancaster county, Pennsylvania, are planning the erection of a new exchange and office building at Manheim, Pennsylvania. The Manheim Telephone company was recently purchased by the above named organization. It is understood that a new system will be installed at Manheim, at on estimated expenditure of $25,000. Officers of this company are, Wm. F. Brossman, president; C. E. Eaby, vice-president and general manager, Ephrata, Pa., D. W. Bunch, treasurer, R.F.D. No. 4, Ephrata, Pa.; and D. W. Artz, secretary, Terry Hill, Pa.

SHOWING BUSINESS HOW
SHOP AROUND THE WOR
by telephon

TIMES like these make the story of Long Distance Service more forceful than ever. Hard pressed business men, hunting for ways to cut costs and maintain profit margins, are glad to benefit by the experience of other businesses. And advertisements like the one on the opposite page hit home.

Notice that this advertisement is based upon the buying practice of a big and progressive business. It explains how Long Distance and Overseas Service can be employed regularly, profitably — and quotes directly a statement of an executive vice-dent. Other manufacturers, re of results, are likely to try the methods. And the offer of a telep plan fitted to individual needs final incentive.

Written in business language appearing in a list of national pu tions that business men read, adv ing of this character serves to s late Long Distance traffic throu the entire telephone industry.

AN ADVERTISEMENT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMP

Identify your inquiry to advertisers by saying—"As shown in TELEPHONE ENGINEER"

The vice-president in charge of purchases says: *"The way business is conducted today, I couldn't function without Long Distance."*

PROMPT AND EFFICIENT BUYING BY TELEPHONE

brings important savings to this large company

THE Procter and Gamble Company manufactures approximately 100 brands of soap, and numerous allied products. Raw materials — cottonseed oil, tallow, greases, palm oil, marine tallow, coconut oil, chemicals, equipment, supplies — are bought from brokers and agents in all parts of the world.

Constant telephone contact is maintained between the purchasing department in Cincinnati and these dealers. Officials state that prompt and efficient buying by telephone often means the satisfactory differential between profit and loss.

The vice-president in charge of purchases "shops" from San Francisco to New York, in making his purchases, without leaving his desk! "I use Long Distance primarily because of the instant service, and the satisfaction of consummating the trade itself quickly and efficiently," he says. Several times a year, he handles important transactions in England and Norway by Overseas Telephone Service.

Long Distance is the modern and economical way to conduct business between men in different cities. It is profitably used by companies of every size in sales, production, traffic, credit and other matters.

The Bell System has developed a Telephone Plan of Market Coverage to help its customers increase their business and cut costs. An experienced telephone representative will gladly help you custom-fit its features to the specific needs of your company.

JUST CALL YOUR BELL TELEPHONE BUSINESS OFFICE

News From the Field

The Bureau County Co-Operative Telephone company is in the process of organization by leading citizens of Bureau county, Illinois. The company will be capitalized for $100,000, and will offer for sale 5,000 shares of stock at $20 per share. It will not be a dividend paying organization, and will not be operated for profit. The cost of the company has been roughly estimated at between $200,000 and $300,000.

The billing office of the Ohio Standard Telephone company which has been located in West Milton, Ohio, since 1928 when the West Milton Home Telephone company was purchased by the larger concern, is to be moved to Columbus, Ohio, in order to centralize the work of the company.

Residents of Rossville, Ind., have petitioned the public service commission for lower telephone rates from the United Service corporation of Monticello.

All accounting for the Oklahoma Telephone company, operating about ten exchanges through Oklahoma, has been turned over to the auditing department of the Northern Texas Telephone company in Sherman, Texas. This step was taken in the direction of concentrating in Sherman the accounting departments of all Texas and Oklahoma telephone companies operated by the Telephone Bond and Share company.

The Galt Telephone company and the Middle States Utilities company have been granted permission to abandon their joint telephone exchanges at Modena, Mo., and Mill Grove, Mo., and to furnish their subscribers' telephone service from their Princeton and Spickard exchanges, by the Missouri Public Service commission.

The Missouri Public Service commission has ordered the Urbana Telephone company to improve and rehabilitate its plant and property in order to render satisfactory and dependable service. This commission also ordered the Osage Valley Telephone company to repair its toll line between Urbana and Preston, Mo., and to improve its telephone plant and property used in rendering long distance as well as local service. Both improvements were ordered to be completed within sixty days.

At the recent annual meeting of stockholders of the Western Electric company all the directors were re-elected. The capital of the Western Electric company was reduced from $180,000,000 to $142,500,000 by the transfer of $37,500,000 from capital to surplus. The company's capital had been increased by this amount in 1927 and 1928 by transfers from surplus.

Indiana Bell Telephone company has been authorized by the Interstate Commerce commission to acquire $16,000 properties of the Lawrence Telephone company, which operates a small exchange on the outskirts of Indianapolis.

Southwestern Bell Telephone company was authorized by the Interstate Commerce commission to acquire the properties of the Creve Coeur Mutual Telephone company in St. Louis County, Mo., for $89,124. The Southwestern company was also permitted to acquire the properties, rights and franchises of the Ballwin Mutual Telephone company, operating in Manchester, St. Louis County, for $81,827.

Orville Baker of Shelbyville, Ind., owner of the telephone exchange at Blue Ridge, Ind., has filed a voluntary petition in bankruptcy in Federal court at Indianapolis, listing assets at $2,775.15 and liabilities at $3,035. Mr. Baker has been proprietor of the Blue Ridge exchange for several years.

Work to provide additional outside telephone plant at Kewaunee, Wisc., has been started there by the Wisconsin Telephone company, owner of the Kewaunee exchange. An expenditure of $4,000 is required. The project includes the placing of about three-quarters of a mile of additional aerial cable. Currently, the Kewaunee exchange serves 1,096 subscribers' telephones.

Permits for building the new Illinois Bell Telephone plant in Winnetka, Ill., were issued in Winnetka in the last month. The building, which is to cost $71,000, is now under construction.

The Nelson Telephone company at Nelson, Wisc., has been granted permission by the Public Service commission at Madison to issue $6,000 worth of common stock to pay outstanding indebtedness and to pay a stock dividend. The company provides service for Nelson and tributary territory in Buffalo county.

The Ohio Bell Telephone company has estimated that it cost $35,000 to repair lines crippled by recent Ohio spring storms.

The Northern Ohio Telephone company has reported that it was required to replace a number of poles and several miles of wire in the country destroyed by recent storms.

The Illinois Bell Telephone company announces a reduction in the working hours of all employees with an equal reduction in pay. Effective April 16 all officials and employees who had not already taken a reduction in working time, were cut by a minimum of one-half day per week. This cut in time is in addition to the regular day off allowed all employees.

Tents of the nomads of Swedish Lappland, a grazing district about the size of Great Britain, are to be equipped with telephones, according to a dispatch from Stockholm. It is believed the telephones will enable the Lapps to overcome some of the ennui of their lonely lives.

A movement is under way to seek lower rates for telephone patrons in Blissfield, Dundee, and Tecumseh, Mich., and vicinity. A delegation of Dundee business men met with a similar group from Blissfield, recently, and discussed the possibilities of forming a co-operative movement to induce farmers who had recently cancelled their telephone subscriptions, to re-install telephones in their homes. Exchanges in Blissfield, Dundee and Tecumseh are operated by the Associated Telephone company.

The Wisconsin Telephone company plans to spend $11,000 for construction of additional plant for its Oconomowoc, Wisc., exchange. Additions to outside plant will involve an expenditure of $5,000, according to A. K. White, manager of the Oconomowoc exchange. Work in connection with the installation of subscribers' instruments and associated equipment will cost $5,000, and $1,000 will be spent for additions to central office equipment.

The Missouri Public Service commission has approved the application of the Scotia Telephone company to abandon its exchange at Brumley, Mo., and to serve the telephone using public at Brumley from its exchange at Ulman, Mo. The Middle States Utilities company of Missouri was also given permission to abandon an exchange at Edinburgh, Mo., and to furnish Edinburgh subscribers service from the Brimson exchange.

Analyze Current Problems at Convention

Pres. Hageman of Ohio Assn. Urges Closer Cooperation Between Independent Companies and Machinery Manufacturers; Emphasizes Advantages of Depreciation Order; Warns Members to Fight Further Telephone Taxation; Advocates Continued Campaigns to Sell Service

Regretting that his annual report, unlike that of many of his predecessors, could not detail continuous and amazing progress, but could only tell of efforts made against the tide of a genetal economic condition which had grown progressively worse and worse, President Herman E. Hageman of Loraine, Ohio, treasurer of the Loraine Telephone company, presented his report before the annual Ohio Independent Telephone Association convention. The two-day convention was held in Columbus, Ohio, April 12 and 13, at the Deshler-Wallick hotel.

President Hageman said it was difficult for persons not closely related to the telephone business to appreciate its responsibilities.

"Unlike most businesses," he said, "we cannot cut our inventory to conform to a lessened demand, nor can we reduce our expense in proportion. Our plants must always be maintained, in good times and in bad times, to care for a peak load. The facilities that we provided during 1928, 1929, and 1930, to take care of normal development for a reasonable period of time, are installed and ready to serve.

"In this depression nearly every company finds that it has from a few hundred dollars to more than $1,000,000 in idle equipment. The large companies have the large amount idle. This equipment must be maintained and kept in an operating condition with a greatly curtailed income.

Rate Schedules Inadequate

"We find now that our rate schedules in the past were entirely inadequate, because the income should have been sufficient in the early years of the life of that equipment to pay not only the interest on the investment, but also to provide for a high rate of depreciation. Many companies are finding it impossible to maintain the proper depreciation rate for later equipment and still pay the interest charges on the investment."

Mr. Hageman said Ohio association officers had endeavored to devise means of keeping up the revenues of the Independent companies.

"While we do not have anything tangible to offer now," he said, "considerable progress is being made. In the summer of 1931 we had several conferences with the Postal Telegraph-Cable company with reference to a contract for the handling of telegrams. An agency agreement has been prepared which is acceptable to some Independent companies.

"The American Telephone & Telegraph company through the Ohio Bell Telephone company has presented a proposition on the operation of teletype machines which, from a revenue standpoint, is far from satisfactory to Independent telephone companies."

Urges Close Relationship With Manufacturers

President Hageman expressed the opinion that it was time for Independent companies to become closely affiliated with each other and with Independent telephone equipment manufacturers, and to assure those manufacturers that they would purchase teletype machines and other modern equipment if they will develop machines and equipment which operate satisfactorily.

"It appears," he said, "as if we are in the same position relative to this equipment that we were back in 1900 relative to telephone equipment."

President Hageman also stated that the association officers had recommended that as soon as machines can be developed, arrangement should be made by adjoining telephone companies for the erection of the necessary circuits to operate these teletype machines between Independent companies and to work out a schedule of mileage rates for those companies that furnish the circuits but do not collect any revenue.

Interstate Commerce Commission Depreciation Order

Speaking of the Interstate Commerce commission Order No. 14700, with reference to depreciation, President Hageman said the advance information from a committee appointed to study the order, indicated that each company will have to make an engineering study of its property to substantiate its figures, which will make the cost of bookkeeping and accounting in the future much greater than in the past. It is because of this additional expense under present business conditions, that the filing date has been postponed to August 1, 1933, and effective date to January 1, 1934, he said.

Admitting that a large number of companies feel that this is not an opportune time to throw the additional expense of such a study on the companies, President Hagemen said the fact remains that the order has been issued and must be complied with. He said the association was particularly interested in having each company make a thorough study of its properties and see that a sufficient amount is set aside each year to retire equipment when it becomes obsolete or worn out. He said if this was not done the companies would run into difficulties in future years.

Presenting Facts to Subscribers

Stating as his opinion that the low point of the depression was reached in the latter part of 1931 President Hageman said:

"We are on the uptrend now. Credits will ease, commodity prices will rise, and in a few months we shall be meeting an increased demand for telephone service."

But he said the period lying immediately ahead is going to be filled with stress and storm for all kinds of businesses, and that a determined effort will be required in order that the telephone industry will survive in a healthy condition.

"We must get facts before the people if we are to maintain our properties and keep faith with all those who depend on us," he said. "In the matter of taxation alone we will be plucked like a fat goose, unless we take the trouble to raise such a disturbance among voters in every locality that tax spenders will not dare impose further unfair burdens upon our companies. All these burdens are passed along to the telephone subscriber and the ultimate consumer. The millions of people who do not understand this, must be made to realize it."

The National Situation

Taxes were discussed by Charles C. Deering, Des Moines, Ia., secretary-treasurer of the United States Independent Telephone Association, in an address called "The National Situation."

After discussing the several forms of taxes of direct interest to telephone people such as a ten cent tax per month

per telephone, and a revival of the war-time tax of five cents on toll message from 14 to 49 cents, and ten cents on messages over fifty cents, which had been considered by Congress, he said the House of Representatives had decided on having the five cent tax apply only to messages over 30 cents, and the 10 cent tax on messages over 50 cents.

Mr. Deering expressed the opinion that the Senate was not likely to make any changes in these figures. Experience, he said, proved the tax could be collected easily during war times. Today, however, he said ,conditions are different as people want to conserve expenses in every way possible.

In discussing the general business situation, Mr. Deering said the slowing up of business had given telephone men time for study and introspection, and that those who thought the telephone business depression-proof had changed their minds.

"It is to be hoped that false economy will not be practiced, as that would interefere with service," he stated.

Sales campaigns are making people of telephone organizations more and more sales-minded, the speaker said. He urged emphasizing and selling toll service, saying that it is an important part of the Independent group's service.

Specialists Needed to Sell Telephone Service

"Revenue Building Campaigns," was the subject discussed by Jack Knabb of Rochester, N. Y., of the advertising firm of Lyddon, Hanford & Frohman company. Mr. Knabb declared that it is of no use asking when 1929 business will return. "Get out in your plant, or along the road, and work for it," he said.

He said now is the psychological time for every company to launch a sales campaign to get business, and emphasized the necessity of having specialists in charge of selling telephone service.

Watson is Speaker

A feature of the convention was an address by Dr. Thomas A. Watson, who told of his connection with the builder of the world's first telephone, invention of the telephone and the years of experimenting which preceded its final accomplishment. Doctor Watson spoke of the fellowship that is characteristic of telephone people and emphasized the comparatively short period between the making of the first telephone and the present advanced development of the industry.

Election of Officers and Directors

Directors were elected at the convention as follows: William C. Henry,

(*Continued in last column on next page.*)

Littelfuse Goes to Hollywood

A Movie Thriller in Four Acts, Scenario for Which was Prepared at Littelfuse Laboratories, Home of Littelfuse

The following romantic episode in the life of a Littelfuse, one of the Instrument Littelfuses designed particularly for the protection of very delicate meters, and manufactured by the Littelfuse Laboratories, Chicago, was related in the form of a movie reel by the Littelfuse Laboratories in a recent folder.

The story of the Littelfuse hero is detailed here, just as it appeared in the folder, where it was entitled, "Littelfuse Goes to Hollywood," and described as a "thriller in four acts."

ACT I

In this act the hero (No. 1004-1/8 ampere Littelfuse) and heroine (0-5 volt, 75 ohms per volt) meet. The villain makes a vain attempt to capture the heroine, but fails. Littelfuse is too quick acting. By scene A3, the villain is effectively stopped. A4 the heroine returns uninjured and at A5, all is normal again. Camera speed 64 pictures per second; exposure time .009 seconds per picture.

PRINCIPAL CHARACTERS

THE HERO	THE HEROINE	THE VILLAIN
Littelfuse, Strong & rugged. "Quicker than a Short-Circuit".	Volta Milly Meter Beautiful, but fragile.	Short Cirkute Ovherlode. Merciless and treacherous.

V. M. Meter: "Can I trust you?"
Littelfuse: "Sure, I'm a very fast worker."

A1—Normal Position.

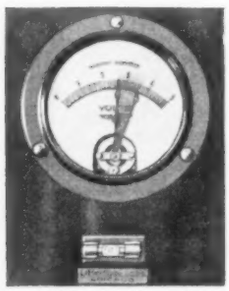
Miss Meter: "I see the villain coming. Come closer Littelfuse."

A2—1/64 Sec. has elapsed.

V. M.: Meter: "He's after me! Quick Littelfuse — save me — save me."

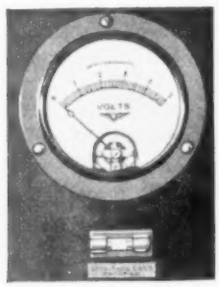
A3—1/32 Sec. has elapsed.

Littlefuse: "Don't worry little girl—I've got him in the open."



A4—3/64 Sec. has elapsed.

V. M. Meter: "You're so quick and brave, Littelfuse—what a man!"



A5—5/64 Sec. has elapsed.

V. M. Meter: "I'm so Meter-Happy now."

ACT II

In this act the hero (No. 1002-1/32 ampere Littelfuse) again protects the heroine (30-0-30 galvanometer, 22 m. m. a. per div.) against the advances of the villain. Our favorites are becoming more friendly on better acquaintance. Camera and exposure time unchanged. H'they are!

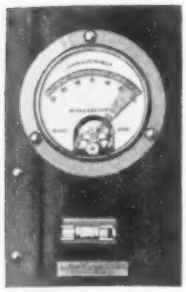
V. M. Meter: "Protect my jewels Littelfuse."
Littelfuse: "I'd just blow myself for you."

B1—Normal.

V. M. Meter: "I'd just love a quiet little place—."

B2—1/64 Sec. has elapsed.

V. M. Meter: "Oh, the villain. He's after me again. Oh—"



B3—1/32 Sec. has elapsed.
V. M. Meter: "Quick Littelfuse, quick—atta boy --goody."

B4—3/64 Sec. has elapsed.
V. M. Meter: "That seemed so easy—it's almost too good to be true."

B5—5/64 Sec. has elapsed.
V. M. Meter: "I'm so secure when you are with me Littelfuse."

ACT III

Having defeated the villain so thoroughly, our hero leaves Miss Meter momentarily, but the villain is ever on the alert—ever ready to seize the beautiful but fragile heroine. In a split fraction of a second this beautiful romance becomes darkened with the shadow of tragedy.

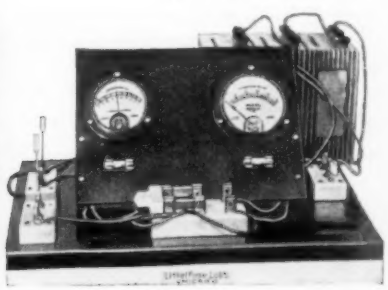
V. M. Meter: "Oh! Please, please don't. I'm only a little hard woiking goil."

C1—Normal.
V. M. Meter: "He's after me—he's after me—Littelfuse."

C2—1/64 of a second elapses
V. M. Meter: "He's got me—Oh—I'm burning up--OH!"

Ovherlode: "I got you this time, my little hair spring damsel. Take that! ha, ha"

C3—1/32 of a second has elapsed.
V. M. Meter: "OH ——."



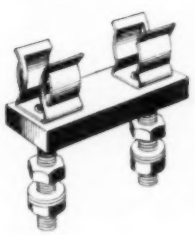
Test panel on which motion pictures were taken.

ACT IV

Littelfuse: "We need each other, darling."
V. M. Meter: "Yes, dearest."
Littelfuse: "Let's get tied up—for ever."
V. M. Meter: "When—?"
Littelfuse: "Right away—now!"

THE END

No. 1010 Open Type Instrument Littelfuse Mounting. Black bakelite base. Highest quality phosphor bronze nickel plated clips.



No. 1050 Panel Type Instrument Littelfuse Mounting. Black bakelite; clips as above; studs 1 inch long.

High Voltage Littelfuse in porcelain mounting. See chart on this page for sizes.

A copy of this interesting folder and further information regarding Littelfuses may be secured by addressing the Littelfuse Laboratories, 1764 Wilson avenue, Chicago, Ill.

Bellevue, general manager, Northern Ohio Telephone company; Frank L. McKinney, Columbus; C. L. Jones, Athens, secretary and general manager, Athens Home Telephone company; E. G. Miller, Warren, general manager, Warren Telephone company; and E. G. Morgan, Eaton, division superintendent, United Telephone companies. Mr. Henry and Mr. Morgan are new members, the others having been reelected.

Herman E. Hageman was reelected president, and other officers chosen were: vice-president; W. L. Cary, of Newark, president of the Newark Telephone company; and secretary-treasurer, Frank L. McKinney, of Columbus.

GORMLEY TO ADDRESS CHICAGO MEETING

The Telegraph and Telephone section of the American Railway Association will hold its fifteenth annual session Tuesday, Wednesday, and Thursday, June 7, 8, and 9, at The Stevens Hotel, Chicago.

An address will be given by M. J. Gormley, Executive Vice-President, American Railway Association.

A demonstration on noise induction will be presented by H. R. Huntley of the American Telephone and Telegraph company. This will be followed by discussion on the demonstration and on the principles and practices for inductive coordination of railway electric supply facilities and the communication facilities of the Bell System, by the following: W. H. Harrison, plant engineer, H. L. Huber, engineer on foreign wire relations of the American Telephone and Telegraph company, and I. C. Forshee, chairman committee on inductive interference.

Informal talks will be given by H. A. Affel of the American Telephone and Telegraph company, whose subject will be Telephone Repeaters for Train Dispatching and Message Circuits, and F. A. Cowan, engineer of transmission of the Long Lines department of the American Telephone and Telegraph company, who will talk of the Application of Terminal Repeaters in Connection with Tie Trunks of the Railroads.

There will also be committee reports and election of officers.

The United Telephone company is making plans for its annual spring survey. Subscribers in the various exchanges over the country will be visited and a general check-up of service made. All the employees of the company take part in this campaign.

Developments in Telephone Transmission

Paper Read Before South African Institute of Electrical Engineers by J. W. Keefe Gives Early History of Vacuum Tube Repeater, Includes a Thorough Description of Its Elements and Operation, and Tells How It Changed Recognized Standards of Practice in Telephone Plant Design

The limiting factor in telephone transmission is, or was, the telephone line. Efforts to increase the range of transmission by the production of more efficient or more powerful transmitting and receiving apparatus could not in the nature of the case effect any great improvement. The introduction of loading coils, while increasing very considerably the working range of open wire lines, and making the use of cables possible where their application had up to then been out of the question, also indicated that the practical limit had been arrived at, unless some new method of solving the transmission problem were discovered. At the same time it was evident that if satisfactory transmission could be obtained over still greater lengths of line than was possible even with loading there would be a demand for such telephone service which would result in commercial success, provided, of course, that the cost factor was not increased out of proportion to the benefits obtained.

Owing to the development of the vacuum tube repeater it may be said without exaggeration that the limits over which speech may be transmitted effectively have been practically removed. It is now possible to hear a person speaking 3,000 miles distant as distinctly as if he were a telephone subscriber in the same local area. The utility to the commercial community in South Africa of being able to speak without difficulty between Capetown and Johannesburg, or, say, Capetown and Bulawayo, would be very great. The cost per message would necessarily be high, but if a business matter is of such importance that a telephone message regarding it may save or gain hundreds or thousands of dollars then the cost of sending such a message would be small compared with the possible resultant benefit.

The apparatus (generally termed a "repeater set") which has been developed in recent years, for achieving such a result, acts in such a way that speech currents attenuated by their journey over a long line are amplified and sent on, practically unchanged in form. It is therefore sometimes called a "telephonic relay," or "speech relay." (This term, although not intrinsically wrong, is apt to be misleading as the word relay is almost inseparably associated in the minds of most electrical engineers with an electro-magnetic-mechanical device, which the latest kind of repeater, depending on the action of a vacuum tube, is not.) If the repeater set is properly designed and used with suitably constructed circuits and associated apparatus, several successive repetitions can be made at different points in a very long line, but as will be shown later, it is important that due attention be given to the conditions provided by the line and apparatus used, including transmission apparatus, signaling devices and (in the case of super-imposed working) telegraph apparatus also. Evidently the use of repeaters will cause considerable

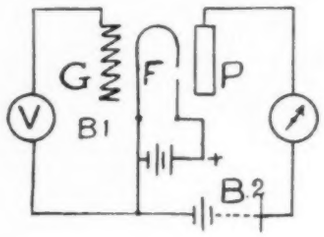


Fig. 1.

changes in recognized standards of practice in plant design and construction. For example, it has been found in numerous cases that it is no longer necessary to load overhead lines of large gauge as the desired improvement can be obtained more cheaply by using repeaters. Similarly small gauge conductors, or cables, can be used where formerly conductors of very large gauge would have been necessary.

As a result of this introduction of the repeater, Washington and Boston—about 500 miles apart—are now directly connected by cables, and the system is rapidly being extended to the principal eastern towns of the United States, practically all of the cables now being installed having loaded No. 16 or No. 19 A. W. G. conductors, with repeaters.

Electro-Mechanical Repeaters

The earlier attempts to produce a telephone repeater were based on the obvious plan of causing the diaphragm of the receiver at the end of a section of line to transmit its vibrations directly to that of a transmitter connected to a separate source of power. The electro-mechanical repeater invented about 1904 by H. E. Shreeve (then with the American Bell Telephone company), which has been continuously improved and was till recently in extensive use, was of this type. Another possible solution of the problem which has been worked on by Drs. Pupin, Campbell, and others, is that using for a repeater element a generator whereof the armature would be the output circuit and the field winding the input circuit. Difficulties of commutation, and the high peripheral speed required, and the fact that the impedance of the input circuit was not independent of the frequency of the received current rendered the application of this type of apparatus to commercial telephony impractical.

The suggestion was made in 1900 by Joseph Lyons to use as a repeater an asynchronous generator, whereof the stator should be bridged across the telephone line and serve both as the input circuit and output circuit, the theory being that the interaction between the stator current received from the line and that induced in the power-driven short-circuited rotor would result in the generation of additional energy of the same wave form as the received current. The adoption of this scheme was also impracticable both on account of difficulties with peripheral speed, clearance, etc., and the fact that the amplification of harmonics of lower frequencies would be greater than that of the higher ones, resulting in distortion.

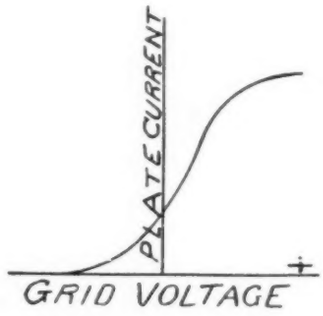


Fig. 2.

Electro Repeaters

These depend upon the emission of electrons from an incandescent body in a vacuum. It was shown by Dr. Lee de Forest in 1906 that this stream of electrons could be so controlled by the addition of other electrodes that a received current could be amplified by their means.

From this the three electrode "audion" or vacuum tube repeater element for use in telephony has been developed, prin-

cipally in America, to the extent indicated in the introductory portion of this section. Time will not permit of the discussion of the theory of the 3-electrode vacuum tube repeater here, and I would refer those interested in the subject to the books and scientific papers listed in the bibliography appended to this paper. Briefly stated, the action is as follows:

If A (Fig. 1) be a vacuum tube having a filament F, raised to incandescence by current from a battery B1, and a grid G and plate P connected as shown, a current will flow from battery B2 between the plate and the filament. Then if a potential difference V be applied between the grid and the negative terminal of the filament, the field between the plate and filament is altered and the current in the plate circuit is correspondingly altered. If the grid is positive with respect to the filament, the current in the plate circuit is increased. If it be made negative, the plate current is decreased, but no current flows in the grid circuit. It is found that if the plate voltage is altered the form of the grid voltage V and plate current I curve representing the relation between (Fig. 2) is not altered, but the magnitude of the current is changed, and that the current in the plate circuit may be altered either by altering the plate voltage, or by a much smaller alteration of the voltage applied to the grid circuit. The device thus gives a voltage amplification.

Telephone Repeaters in Practice

(1) In discussing the application of telephone repeaters to commercial telephony the following definitions should be kept in mind, and the distinction observed between the repeater element, the repeater circuit, and their combination, the repeater set.

A telephone repeater set may be defined as equipment inserted at some point in the line for the purpose of amplifying voice currents transmitted in either direction over the circuit.

The repeater elements is that part of the equipment which receives, amplifies and retransmits telephone currents in one direction only.

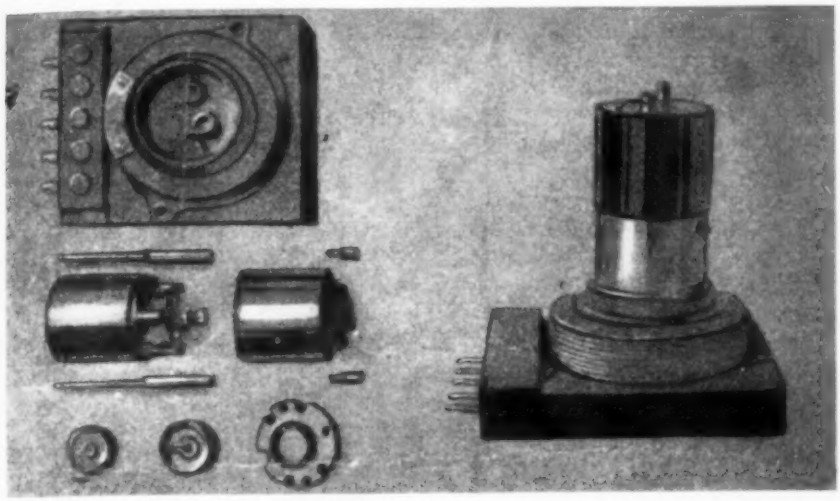


Fig. 3. Mechanical type telephone repeater element, showing socket cartridge and principal parts.

The repeater circuit is that circuit arrangement which enables one or more repeater elements to give amplified transmission in both directions.

Types of Repeater Elements

(2) All repeater elements act on the principle of the control of a local source of energy. I propose to describe in a general way the operation of the two types which have been developed for commercial use and are now classed among the standard apparatus in regular use by the American Telephone & Telegraph company and its subsidiaries.

Mechanical Repeater Element

This element, known as the No. 3a, is the latest development of the Shreeve receiver-transmitter type. Fig. 3 shows the element, which is mounted in cartridge form, its principal parts, and the socket which permits of its ready insertion in or removal from the repeater circuit. Repeater sets using this element will produce under the most favorable conditions an improvement in transmission of sixteen M.S.C. They can be satisfactorily operated "in tandem," that is to say, two or more sections of line, each having a repeater can be connected together. Two or more repeaters cannot be connected to the same line at the same office to give greater amplification, as each repeater set requires for its operation a certain minimum length of line on each side of it. The first cost of this type of element is less than that of the vacuum tube type, and the power and maintenance costs are somewhat lower, but it is not so free from distortion and variability as the latter. Also, the inertia of the moving parts renders it less sensitive. Consequently its field of usefulness is restricted, and it has now been almost entirely superseded by the vacuum tube element.

Fig. 4. Tube with glass bulb cut away. *Fig. 5. Vacuum repeater Element, showing tube in socket.*

Vacuum Tube Repeater Element

Fig. 4 shows a vacuum tube repeater element and the socket for holding it, and Fig. 5 an element with the glass bulb removed. The element consists of a glass vacuum bulb having three electrodes sealed in it, viz., a filament, plate and grid. When heated by an electric current the filament becomes a source of free electrons which travel in a continuous stream from filament to plate, under the action of an applied potential of about 130 volts. In the photograph the grid is shown between the filament and the plate. As indicated previously, as the number of electrons emitted by the filament, and therefore the plate current depend on the field strength at the filament, produced by the combined potentials of the plate and grid, changes of potential between grid and filament will produce corresponding changes in the plate current As the moving parts concerned have infinitesimal inertia, the latter follows the former practically instantaneously, consequently the reproduction in the plate circuit of energy changes in the grid circuit is very close. Hence if the grid voltage be that due to speech waves, we can amplify these without appreciable distortion to any desired degree. Also, as the magnitude of these energy changes is proportional to the voltage variations on the grid, the latter voltage should be multiplied as much as possible before reaching the grid. For this purpose a step-up transformer is usually employed, having a ratio of 30 or 40 to 1. To transform the changes in the plate current into an alternating current the primary of another transformer is connected to the plate circuit, the secondary being connected to the outgoing line. Besides these, certain other appa-

ratus must be associated with the element to produce a complete and efficient amplifying device for telephone work. These include retardation coils placed in the common battery circuit to prevent cross-talk between sets, resistances for regulating the filament current and some type of potentiometer for varying the amount of amplification. A small potential battery, C, must also be applied to the grid, but there is no current drain on this. The general relation of this apparatus is shown in Fig. 6.

Repeater Circuits—Transmission Features

Several different methods have been proposed for obtaining transmission in both directions from single-way amplifiers, but that adopted as the basis of practical commercial repeater circuits is the Wheatstone bridge arrangement. This arrangement, devised for preventing signalling in one direction from interfering with that in the opposite direction has been familiar to telegraph engineers, in its application to duplex telegraphy, for many years. The bridge

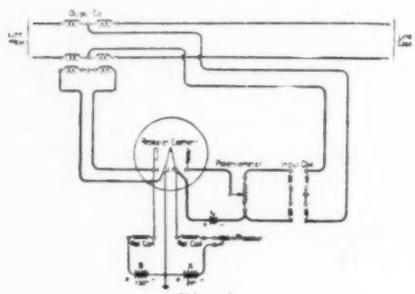


Fig. 6.

circuit has taken several forms in telephone repeater practice.

The "21-Type" Repeater Circuit

This was the earliest application of the bridge circuit to a two-way single element repeater. A simple arrangement is shown schematically in Fig. 7. The basis of this arrangement is a specially balanced output transformer. If this is properly proportioned to the impedances of the line, repeater input, and repeater output, and the line impedances in each direction are identical, the single element will repeat in both directions without interference. The operation may be followed by tracing the currents in the "line west" to be repeated in the "line east." Current coming into the repeater from the west divides, part being transmitted directly to the line east unless the circuit is ideally proportioned, but the greater part is further divided between the output and input circuits. That flowing into the output circuit is dissipated, but the energy flowing into the input circuit is amplified by the repeater element and passes to the "output coil." At this point, if the lines east and west are similar in characteristics, half the energy goes east and half west. The latter serves no useful purpose, but the half going to the east is the desired amplified transmission which may be many times greater than the original amount arriving at the repeater from the sending end.

Referring to Fig. 6, the output transformer has two secondary windings with a tap at the exact center of each, to which the input coil of the grid trans-

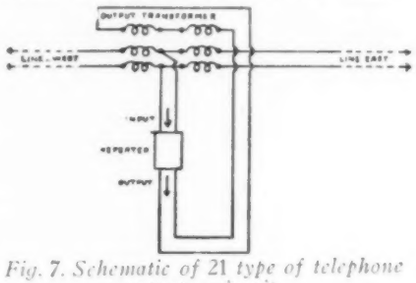


Fig. 7. Schematic of 21 type of telephone repeater circuit.

former is connected. If now the impedance of "line east" balances that of "line west" at all frequencies the input circuit is the diagonal of a balanced Wheatstone bridge, whereof the line impedances and the halves of the output windings are the arms. Consequently current outgoing from the element sets up no P. D. across its input terminals. If the line impedances are unequal, even if only at certain frequencies, unbalanced potentials are produced at the terminals of the input circuits and re-amplified. If the amplification is sufficient to cause unbalanced potentials equal to and in phase with those originally set up, the process will be continuous, and "howling" will occur rendering the device useless as a telephone repeater. Hence the degree of amplification which can be introduced in any line is definitely limited by the degree of balance which can be maintained between the sections on either side. Other limitations of the 21-type circuit will be discussed in the description of the

22-Type Repeater Circuit

This repeater circuit is that which has been most developed for commercial use. It is a two-way, two-element circuit, and

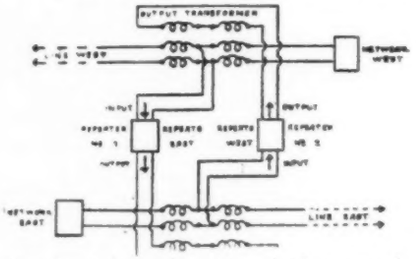


Fig. 8. Schematic types of 22 types of telephone repeater circuit.

is shown schematically in Fig. 8. It is similar in principle to the 21-type, but has a separate repeater element for transmission in each direction, and the two Wheatstone bridge circuits it requires are made up by balancing each line by an artificial network, instead of by the other line. Its operation is briefly as follows:

Telephone currents incoming on "line west" divide, the output of Repeater No. 1 is transmitted through the second transformer to "line east" and "network east." This network is designed to imitate very closely the impedance of "line east." If this imitation is exact, no unbalanced potentials are produced at the input of repeater No. 2. If, however, there is a difference in impedance, unbalanced potentials will be set up, amplified and fed back to "line west" and balancing network "west." If these are not identical in impedance, unbalanced potentials are produced, and return to the input terminals of repeater No. 1. Hence with this circuit the degree of amplification possible is limited by the degree of accuracy to which the impedances of each line and its corresponding network can be balanced.

Fig. 9 shows a simplified diagram of the 22-type circuit. It will be seen that

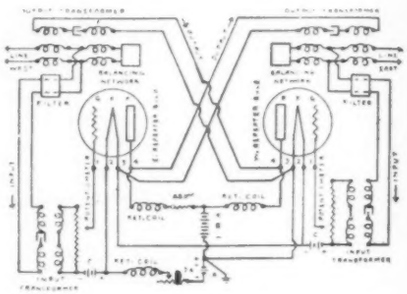


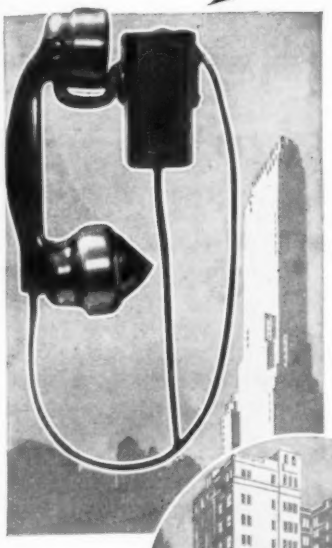
Fig. 9. Simplified diagram of No. 22 telephone repeater circuit.

telephone currents from line west pass from the center points of the output transformer through a filter to the terminals of the input transformer, where their voltage is stepped up, and a portion thereof taken off by the potentiometer to the grid of the "east" repeater bulb, the amplifications produced in the plate current as previously described being fed through the output transformer to "line east." Similar process takes place in the reception, amplification and transmission of telephone current from the east.

Balancing Networks and Filters

From the foregoing it will be seen that the provision of accurately designed balancing networks is of vital importance if the maximum benefit from a repeater circuit of the type described is to be obtained. It has been found possible, if the line is uniform in character, to design networks of a comparatively simple type to fulfill the requirements. On a non-uniform line, however, namely, one having a length of cable inserted in an open wire circuit, or having loading coils of varying inductance or inaccurate spacing, irregularities in the impedance characteristics of the line are produced and the difficulty of the problem is increased. Balancing networks consist of combinations of resistances, inductances and condensers, arranged to offer the desired impedance at telephonic frequencies. These have been reduced to very simple form for all commercial types of tele-

Telephones They Like!



There is Nothing Finer than a Stromberg-Carlson

City or country . . . in the office or in the home, Stromberg-Carlson Telephones transmit and receive voice impulses clearly. Telephone users like them.

Stromberg-Carlson Telephones are quality instruments, built to stand severe use, operate economically, and meet all telephone requirements. Telephone companies like them.

The Stromberg-Carlson Central Energy Deck Telephone is of rugged construction that makes it a practical instrument for any location. Its transmission qualities are unsurpassed.

The Stromberg-Carlson Hand Set Telephone is light and well balanced and so designed that one naturally talks directly into the mouth piece. It is ideal for either extension or main station purposes.

In the office, the Stromberg-Carlson Suspended Type Hand Set is out of the way, yet always accessible.

The Stromberg-Carlson Wall Type Magneto Telephone is ideal for rural use. Its high efficiency, low battery consumption transmitter assures economical operation as well as satisfactory service.

Write for Bulletin 115.

Stromberg-Carlson Telephone Mfg. Co.

Pacific Coast Representative
Garnett, Young & Co.,
San Francisco, Cal.
Los Angeles, Cal.
Portland, Ore.
Seattle, Wash.

Factory and General Offices:
100 CARLSON ROAD, ROCHESTER, N.Y., U.S.A.

Branch Offices:
CHICAGO, ILLINOIS KANSAS CITY, MISSOURI TORONTO, CANADA

OHIO REPRESENTATIVES
J. E. Finley
189 N. Powell Ave., Columbus, Ohio
C. E. Heston
201 N. Bishop Ave., Oxford, Ohio

Southern Representative
Scoville Mercantile Company,
Atlanta, Ga.

Stromberg-Carlson

phone line of uniform construction, but their proper determination for different types of circuits is still a matter requiring considerable care and experience.

The filter shown in the circuit diagram consists of an arrangement to permit the passage of periodic currents of frequencies within the range of normal speech currents, but to cut off those of frequencies above or below this range. By the use of the filter the difficulty of preventing singing on the 22-type circuit can be greatly simplified. Under the best conditions repeaters of the 22-type will give an improvement in volume equivalent to 18 to 20 M.S.C. at 200 p.p.s. On long circuits several repeaters may be used in tandem at properly spaced intervals. It has been found in practice, that on long tandem circuits it is preferable to obtain moderate amplifications at a number of points rather than to attempt maximum amplification at a few points. The improvement on such a circuit cannot in general exceed 75 per cent of the total attenuation of the line.

Comparison of the 21 and 22-Type Circuits

The following are the relative advantage of the 21 and 22-type repeater circuits. The former takes about half the space, apparatus, and power required by the latter, does not require balancing equipment, and has the minimum initial and maintenance cost, but will operate satisfactorily only between lines of similar character. The 22-type circuit can be employed between lines of widely different characteristics, so long as each line is provided with a suitable balancing network. The 21-type must be equidistant from the ends of a trunk line, as otherwise the terminal apparatus will affect the impedance at the repeater station to a greater extent in one direction than in the other, limiting the amplification by increasing the difficulty of balancing.

Other disadvantages of the 21-type have to be considered when the future expansion of the telephone plant and possible extensions in the use of repeaters are taken into account. It is not suitable for tandem operation, as part of the amplification is sent back to the origin, and if the attenuation between repeating stations is nearly compensated for by the repeater, an echoing effect will result, seriously affecting the quality of transmission. Where unbalance between two lines is present, as is always the case in practice, the 21-type will give more gain in one direction that the other. The 22-type is inherently more stable and to be preferred for general application.

Another development in repeater practice which is rapidly approaching the commercial stage is the four-wire transmission circuit.

The Four-Wire Repeater Circuit

In this method, the circuit consists of four conductors instead of two, one pair being used for transmission in one direction and the second pair for transmission in the other. A circuit of this type is shown diagrammatically in Fig. 10. Evidently in such an arrangement, as only one-way repeaters are needed, balancing difficulties are almost entirely eliminated, and the repeaters may introduce sufficient amplification to annul the entire attenuation in the four-conductor portion of the circuit. Moreover, the gain permissible at each station may be from 20 to 30 M.S.C., the only limitations being possibility of cross-talk and external disturbance. It should be noted that the term "four-wire" does not necessarily imply that four wires are used, but that different circuits are used for transmission east and transmission west. Each of these may be a pair of wires, or a found unsatisfactory when repeaters are phantom circuit, etc. At the ends of the four-wire circuit the two branches have to be brought together for connection to two-wire lines, and at these points balancing networks are introduced to minimize the effect of circulating currents which may be set up and flow over the two sides of the circuit in series. It should be noted that although this current uses twice as many conductors as the ordinary circuits, it permits the use of smaller wires. For long-distance cable operation and special cases they have been found economically applicable.

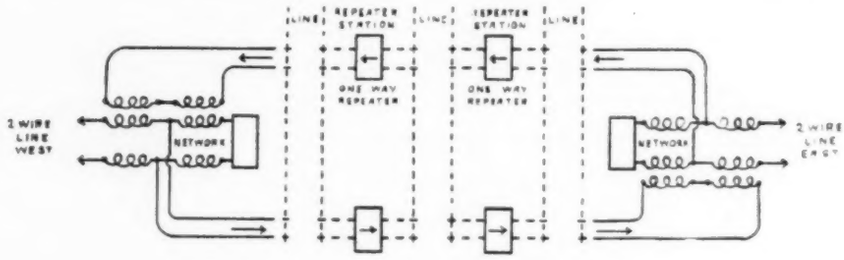


Fig. 10.

Operating Features of Telephone Repeaters

Two general types of repeater equipment have been devised to either of which the mechanical or vacuum tube element is applicable, and are known as the "cord circuit repeater" and "through line repeater." This latter is inserted permanently in a long trunk line to improve the transmission efficiency. The former is used to connect trunk lines together in building up long-distance connections where there is insufficient traffic to warrant a direct circuit, or when the direct connections are already engaged.

The cord circuit repeater forms part of a cord circuit equipment under the control of an operator. The circuit terminates in two double plugs on the operator's position so that she cannot connect together any two lines terminating in the toll line multiple in front of her which are equipped for repeater operation.

Such lines are provided with two jacks, one connected to the line itself and the other to its corresponding balancing network. The amplification given by the repeater is under the operator's control, and is regulated by a potentiometer which may be set in different positions by four relays; these relays being governed by a special four-position sliding key in the key shelf of the position. The first position of the key connects the repeater into the cord circuit and closes the "A" battery-filament circuit. It also connects the repeater to the line, giving comparatively low amplification, which may be increased by successive steps of the key.

The through line repeater is permanently associated with a particular toll line, which does not terminate at the repeater office. It is in circuit at all times so that its power consumption is much greater than that of the cord circuit type. Through signalling is obtained by means of relays which temporarily remove the repeater from the circuit. Through repeaters may be equipped for 16⅔ or 135-cycle ringing current, depending on the ringing efficiency of the repeating coils on the toll line and the type of apparatus to be operated at the terminal offices. Both cord circuit and through repeaters may be assembled on one of two types of mounting, the Unit type or the Relay Rack type. The Unit type mounts one cord circuit or two through-line repeaters, takes up one square foot of floor space and is 6 feet in height. The Relay Rack type of mounting is more economical of space where a number of repeaters are to be installed in one room.

Power Plant Requirements

As indicated in the circuit diagrams, three sources of electric power are required for vacuum tube repeaters, viz., (1) the storage battery of 24 or 48 volts for the supply of current to the filaments, (2) that for the plate current at 130 volts, (3) that for maintaining potential on the grid. The last is usually composed of sufficient dry cells to give a potential of about nine volts. Not being subjected to any current drain this battery requires renewal only when it has

deteriorated with age. "A" current is supplied by the regular 24 or 48 voltage exchange battery if this has sufficient reserve capacity, but a duplicate set is advisable to avoid operating the repeaters from a battery while it is being charged. The filament current should be kept within specified limits as the amount of current has an important bearing on the life of the vacuum tubes. The current consumption per through-line repeater is about 33 amp. hours in 24 hours at 24V. The consumption of a cord circuit repeater depends, of course, on the time it is in actual service.

For the "B" battery a separate charging equipment and storage battery are installed, the voltage being 130 for maximum gain and 120 for moderate gain. If the negative terminal of the "A" battery is earthed these figures must be increased by about 15 volts.

Maintenance

The cost of maintenance of repeater installations is small. The average life of a vacuum tube is about 1,500 working hours, provided it is not worked with a too heavy filament current.

Relation of Repeaters to the Telephone Plant

(1) *Phantomed and Composite Lines.*—In the foregoing, the repeater has been considered only as associated with simple lines. It may, however, be used on any of the usual types of super-imposed or combined telephone and telegraph circuits. Both loaded and non-loaded phantomed aerial and cable circuits may use repeaters both on the physical and phantom circuits.

(2) *Importance of Uniform Line Impedance.*—From the discussion of the action of repeater circuits in the preceding pages the importance of uniformity and impedance in the line and particularly the essential feature that this impedance shall not vary irregularly with frequency, is manifest. Various irregularities in the line make the curve connecting variations of frequency with impedance irregular, and consequently in some cases it is difficult or practically impossible to produce an artificial network to stimulate the line characteristics.

Equipment at intermediate points, such as cord circuits, bridge stations, phantom coils, etc., will introduce irregularities and should be eliminated where practicable. Short lengths of cable in open wire lines and in loaded lines introduce impedance irregularities, and it may be said that in general a circuit on which repeaters are to be used should be made up as uniformly as possible throughout its entire length.

Loaded lines are much more subject to differences in their impedance characteristics than non-loaded lines, owing to inaccuracy in spacing and differences in the inductance of the loading coils. The introduction of repeaters has necessitated research in the improvement of loading coils, the older type of coil being used, being subject to magnetization from lightning and other causes. The changes in inductance resulting from this magnetization result in non-uniformity of impedance in the line circuit. To overcome this defect several new types of repeating coil have been devised, possessing the necessary stability. The new coils constitute a considerable advance in loading practice, the basis of the improvements being the use of material for the cores having high magnetic stability and low losses, and a different cord structure from that used in the older type coils. Accurately uniform spacing of loading coils in circuits using repeaters is much more important than on ordinary circuits, it having been found necessary to reduce the former allowance of 5 per cent variation from the theoretical loading point to 2 per cent. The practical problems arising from the necessity of securing uniform impedance characteristics of lines and networks at different frequencies has led to the development of a range of apparatus for measuring impedance rapidly and accurately in the field, and also for the determination of transmission efficiencies over the whole range of normal telephone frequencies. The use of repeaters has simplified the problem of maintaining satisfactory standards of transmission on long-distance service, and it is now considered that the total transmission loss between subscriber and subscriber on any connection should not exceed 30 miles M.S.C. This reduces the maximum toll line allowance between the test-boards to twelve miles M.S.C.

Transcontinental Line

In the earlier part of this paper the New York-Denver circuit was described and the circuit shown schematically as it existed in 1911.

A striking result of the application of repeaters is the extension of this circuit to San Francisco opened in 1915 and the reduction of the total transmission equivalent over the 3,400 miles between New York and the Pacific coast to 21 miles of standard cable. Fig. 11 shows this circuit set up for through connection.

It will be noted that provision is made for three simultaneous telephone conversations, and also eight telegraph messages, a remarkable development in a short period.

Economic Considerations

In order that a telephone system be satisfactory, viewed from the economic standpoint, it must involve the minimum possible annual expenditure over a term of years. This result can only be obtained if the different parts of the system are designed to be in "cost equilibrium." This principle was crudely stated in the section in the first part of this paper dealing with the influence of transmission problems on the design of minor apparatus in telephone exchanges. It means that each part of the equipment should be designed as far as possible to perform its work at an annual cost not radically different in percentage of capital expenditure from that of any other part.

The cases in which the question arises whether the use of repeaters will be economically justified may be divided into two broad classes:

(1) Where it is proposed to improve the quality of transmission in an existing installation for the purpose of (a) extending the range of satisfactory service, or (b) increasing the traffic by providing improved facilities.

In this case it would have to be determined whether the desired improvement might be obtained on the basis of minimum annual charges over a given number ing if the circuits are not already loaded, of years by installing repeaters, by loador by replacing the circuits under consideration by new ones of heavier gauge and using the existing circuits for other service. The possible necessity of modifying the line to permit of repeaters being used would have, naturally, to be taken into account.

(2) In the design of a new lay-out. This is a somewhat simple case, as it is easier to provide the most economical scheme as the choice of methods is less restricted. A great number of considerations are involved, however, such as the number of circuits required at the beginning, and for a number of years thereafter, as it may be more economical to install circuits which will be idle for a time than to make additions in the near future. The grade of transmission to be provided must be decided on. The length of line is of great importance, as a scheme which would be economical for a short distance service is not often the most economical for a longer line. Having obtained as accurate details as possible for these and other factors to be included in the study, the probable annual charges on the system, if constructed in any one of several possible ways, must be estimated from experience with similar apparatus under similar conditions. A simple example of such a study is the following:

It is desired to build a line 150 miles long having 150 circuits, the transmission equivalent between test-boards to be 12-14 miles M.S.C. The desired conditions can be obtained by:

(1) An open wire line of No. 12 S.W.G. copper, this having approximately the transmission equivalent specified.

(2) A heavy loaded No. 16 A.W.G.

cable with two-way repeaters near the middle of the cable.

(3) Two heavy loaded No. 13 A.W.G. cables. (*Note*—Two cables would be necessary, as a quadded cable of this size conductor for the total number of circuits would not be economical.)

Of these (3) would probably be slightly more expensive than (1) on an annual charge basis, and either would be about 60 per cent more expensive than (2). Suppose, however, that only one-third of the facilities are required immediately, one-third after 5 years, and the remainder after 10 years, or that about half are sufficient for the first 7 years. Then the open-wire system could be economically installed as required, the second of the No. 13 gauge cables could be laid when necessary, probably at the end of 7 years, while the No. 16 gauge cable could be installed at once, but only those loading coils and repeaters provided that would be needed at once, others being added when necessary. In these circumstances, there would be much less difference between the three plans, but the open-wire line would still be 20 per cent more expensive than the 16 gauge cable, while the 13 gauge cables might be about 45 per cent more expensive. An actual case would, of course, be worked out with far greater precision, based on traffic studies, known costs, probable life of apparatus, etc., this example merely indicating the range of possibilities, and being intended to show roughly the degree of economy that may be obtained under certain conditions by the use of repeaters.

I have endeavored in the foregoing to fulfill the promise given in the opening paragraph of this paper, namely, to present, briefly and clearly, consistent with the extent of the subject, an outline of developments in telephone transmission. In the nature of the case the presentation must be more or less imperfect, and some of the details mentioned as novel may have become ancient history in a very short time. If, however, the paper proves to be of help in the closer study of the subject, and the origin of interesting and valuable discussion, it will have amply served its purpose.

I have to express my indebtedness to the Western Electric company for much of the information in this paper and for permission to use drawings and photographs; to Messrs. Gherardi and Jewett for permission to make use of details and illustrations given in their paper "Telephone Repeaters"; to the numerous contributors to the literature of the subject, references to whose works are scattered throughout the paper and are included in the bibliography; and particularly to H. P. Trainor and Capt. R. T. McArthur (of the engineering department of the Union Postoffice) for valuable assistance in its preparation.

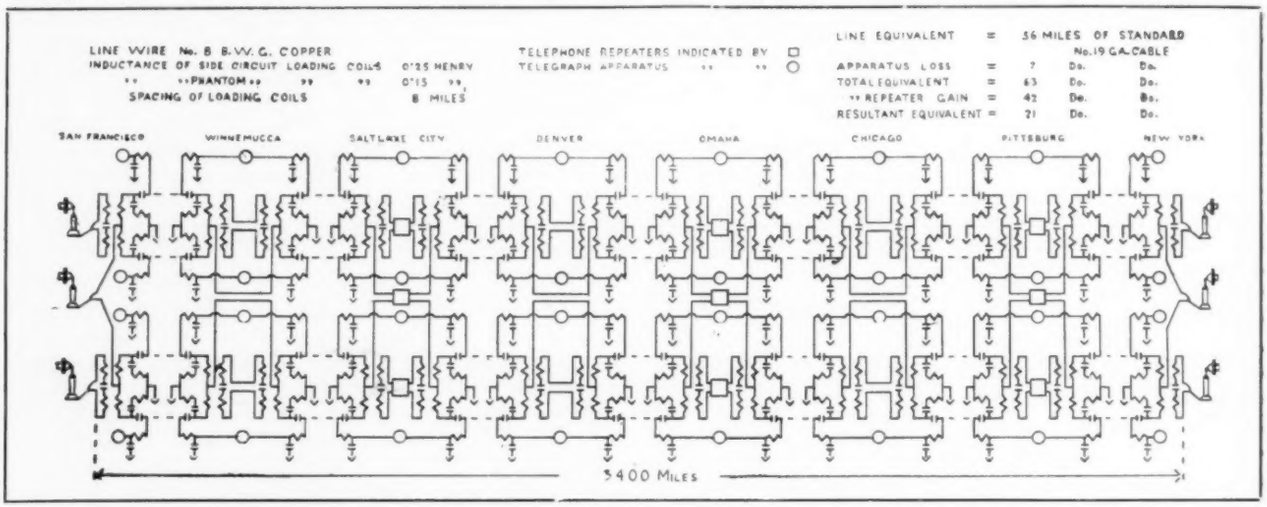

LINE WIRE No. 8 B.W.G. COPPER
INDUCTANCE OF SIDE CIRCUIT LOADING COILS 0·125 HENRY
" " PHANTOM " " " 0·113 "
SPACING OF LOADING COILS 8 MILES
TELEPHONE REPEATERS INDICATED BY □
TELEGRAPH APPARATUS " " ○
LINE EQUIVALENT = 56 MILES OF STANDARD No.19 GA. CABLE
APPARATUS LOSS = 7 Db. Db.
TOTAL EQUIVALENT = 63 Db. Db.
" REPEATER GAIN = 42 Db. Db.
RESULTANT EQUIVALENT = 21 Db. Db.
SAN FRANCISCO
WINNEMUCCA
SALT LAKE CITY
DENVER
OMAHA
CHICAGO
PITTSBURG
NEW YORK
5400 MILES

Fig. 11. *This circuit provides for three simultaneous telephone conversations between New York and San Francisco. At the same time it provides for four telegraph messages in each direction.*

VACUUM TUBE THEORY AND PRACTICE

(*Continued from page* 18.)

frequency and the other being variable. The output of the two high frequency oscillators is fed into a modulator tube where the frequencies of the respective oscillators are combined resulting in the appearance in the plate circuit of the modulator tube of three frequency components; viz, the sum frequency of the two oscillators, their difference frequency, and their separate frequencies. By means of a filter all components except the difference frequency is filtered out, thus leaving in the output circuit a low frequency alternating current which may be utilized for any desired purpose.

Inasmuch as the high frequency variable oscillator may be varied over a wide range with an ordinary variable air condenser, the frequency range of the beat frequency oscillator is quite wide.

Commercial oscillators of the "beat frequency" type are designed to cover the voice range (50 to 10,000 cycles) and some go as high as 50,000 cycles. The fixed frequency that is generally selected is 100,000 cycles. The variable oscillator required to give a range of 0 to 10,000 cycles, would need to be variable from 90,000 to 100,000.

To illustrate the principle of operation of the "beat frequency" oscillator, let us consider such an oscillator when adjusted to give a 1000 cycle output. Assuming the fixed frequency oscillator had an output of 100,000 cycles, then the variable frequency oscillator would need to be set on 99,000 cycles in order to produce a difference frequency of 1,000 cycles. In the plate circuit of the modulator tube would appear frequencies as follows: 100,000 (fixed frequency), 99,000 (variable frequency), 199,000 (sum frequency), and 1,000 cycles (difference frequency).

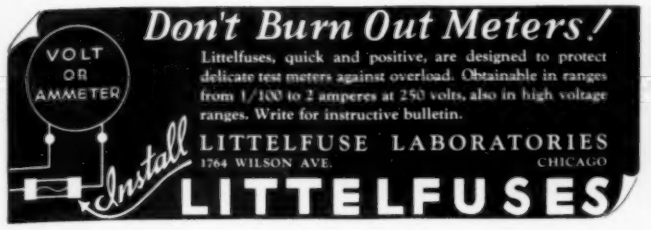
By means of the low pass filter shown, all frequencies except the difference frequency are kept out of the output circuit. Fig. 5 illustrates schematically the principle of the "beat frequency" oscillator.

CONVENTION SCHEDULE

Pennsylvania State Telephone & Traffic Association, Penn-Harris Hotel, Harrisburg, May 17, 18, and 19.

Up-State Telephone Association of New York, Jamestown Hotel, Jamestown, May 25, 26, and 27.

North Dakota Telephone Association, Hotel Powers, Fargo, May 26 and 27.

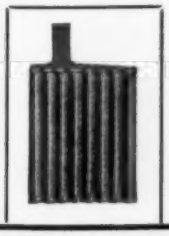


Don't Burn Out Meters!

Littelfuses, quick and positive, are designed to protect delicate test meters against overload. Obtainable in ranges from 1/100 to 2 amperes at 250 volts, also in high voltage ranges. Write for instructive bulletin.

LITTELFUSE LABORATORIES
1764 WILSON AVE. CHICAGO

LITTELFUSES



DEPENDABILITY . . . long life . . . economical operating and maintenance costs are the reasons why the use of Exides is increasing in P. B. X. service.

EXIDE-IRONCLAD P.B.X. BATTERIES

Exide - Ironclad Battery, type B.I.-5, especially designed and constructed for P.B.X. service.

Tubular construction of Exide Ironclad positive plate gives longer battery life.

Exide
BATTERIES

THE ELECTRIC STORAGE BATTERY CO., PHILADELPHIA

W. L. Runzel, President, brings to this organization 41 years' experience in the manufacture of this type of telephone equipment

Telephone and Switchboard Cords and Wire

May we quote you on your requirements?

RUNZEL CORD AND WIRE CO.

4727-31 Montrose Ave., Chicago

The Home of the Perfect Cord

INTERESTED IN TECHNICAL PROBLEMS?

Turn right now to page 47 and select books to equip you to meet every problem which may arise.

We can supply you with any book you desire. Ask for our list of technical books.

TELEPHONE ENGINEER, CHICAGO

Cedar Poles

NORTHERN WHITE **WESTERN RED**

PLAIN OR TREATED BUTTS

Prompt Shipment from Minneapolis Yard

T. M. Partridge Lumber Co.

Minneapolis, Minn.

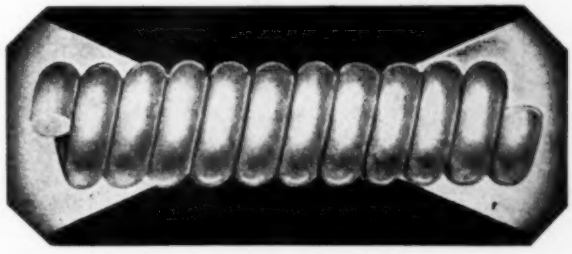
Toll operators are human!

It would be manifestly unfair to place blame on the toll operator who makes mistakes when no better time-keeping tools are provided than a visible indicator of the time of day, and a pencil. The telephone executive who argues that his operators today are personally "more efficient," "more expert," or "more experienced" than those of earlier generations, is only deceiving himself. Even the briefest experience with the Calculagraph proves this to him.

With utmost precision, the Calculagraph mechanically computes and prints ELAPSED TIME. A pull of the handle clearly and indelibly stamps *on the toll ticket* the time of day of each call, also the actual ELAPSED TIME the circuit is in use, for any number of calls. No arithmetic by pencil—no diversion from other duties—no chance of error—the Calculagraph is easily and quickly operated while conversing with either the calling or answering party. The Calculagraph is now supplied in either the well-known spring-driven model or an electric-driven model operated by electric impulses from a master clock (24 or 48 volts), or by self-starting synchronous motor (60 cycle A. C.). Prices and detailed information on request.

THE CALCULAGRAPH COMPANY
50 Church St. Dept. 22 New York City

CALCULAGRAPH
THE ELAPSED TIME RECORDER



Galvanized Telephone Wire and Steel Strand

Crapo Galvanized Wire can be wrapped around its own diameter without injury to its pure zinc coating....That is one of a number of reasons why **Crapo** Galvanized Telephone Wire and Strand can be depended upon to reduce maintenance cost.

Indiana Steel & Wire Co.
Muncie, Indiana

Look for the **Crapo** Seal!

INDIANA STEEL & WIRE CO. Crapo Galvanized MUNCIE IND

Crapo
GALVANIZED PRODUCTS

Telephone News From the Southwest

Notes of Telephone and Utility Interests In the Central Southwest Which Previously Were Reported for Transmitter and Electrical Journal, a Regional Magazine of that District Which Has Been Absorbed by TELEPHONE ENGINEER, Appear in the Following Columns

Pioneer Telephone Man Dies

Frank S. Miller, age 49, a pioneer telephone and lumber man, died at his home at Tulsa, Okla., April 26. Mr. Miller had been engaged in the lumber business in Tulsa for several years prior to his death. Before entering the lumber business he organized a telephone exchange at Grove, Okla., and later merged it with exchanges at Afton, Fairland, Ketchum and Cleora, Okla. These exchanges were later sold to the Pioneer Telephone company, now the Southwestern Bell Telephone company. His body was taken to Seneca, Mo., his former home, for interment.

Ask Modern Equipment

Citizens of Skiatook, Okla., have filed a protest with the Oklahoma Corporation commission asking that the Standard Telephone & Telegraph company install "modern equipment."

Tax Poles and Lines

The city of Okmulgee recently passed an official ordinance with an emergency clause, taxing poles and lines of the Southwestern Bell Telephone company in that city. The new ordinance taxes the telephone company $1.00 for each telephone pole inside the city limits, and $25 for each mile of wire within the city limits whether on poles, in underground cables, or otherwise. Similar ordinances have previously been passed by Tulsa and Muskogee, Okla.

Explains Poor Service

Improper construction of rural telephone lines and inadequate maintenance, plus inefficient installation in the homes themselves are the elements largely responsible for bad service on such lines, declared Charles H. Farris, in charge of the rural telephone division of the Southwestern Bell Telephone company at Ardmore, Okla., in an address before the Ardmore Farm Congress. Rural lines are put up and maintained by the subscribers. The telephone company co-operates in every way possible to provide the best service that can be secured over lines oftentimes improperly built, he stated. He used about 100 feet of wire taken from a rural line near Ardmore to demonstrate how bad connections, improper size and type of wire can cause poor telephone service, and how easily these conditions can be remedied.

Tulsa Seeks Franchises

An ordinance, seeking to compel telephone and telegraph companies operating in Tulsa, Okla., to obtain franchises, was passed at a recent session of the city commission. The ordinance requires franchises to be obtained by June 1st, provides penalty for failure to comply with its terms, and also provides for a schedule of rates to be effective after the foregoing date in the event of failure to obtain a franchise. It provides a tax of $2 for each pole used in both interstate and intra-state business. A provision is also made for 2c tax per foot for underground conduit used in the same way, and a 4% tax on gross receipts after business in connection with long distance calls and messages has been deducted. All are annual taxes, with payments semi-annually.

New Sulphur Exchange

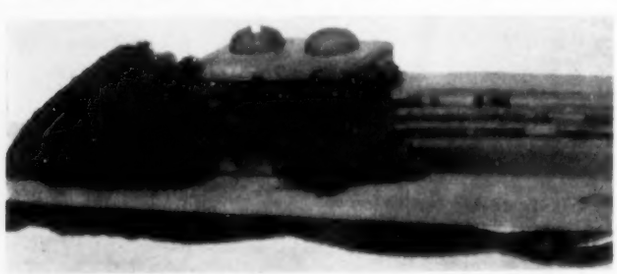
A new telephone exchange and building is being constructed by the Sulphur Telephone company at Sulphur, Okla. Electrical equipment of latest type is being installed. A new switchboard will provide for one additional long distance operator. The operators' room has walls, floor and ceiling of special soundproof construction. The women operators have an attractive rest room, with private entrance in the building. The public entrance leads into a pleasant room where long distance booths are located.

Ants Put Four Party Line Out of Service

By Thos. P. Carlyon, Associated Telephone Company, Ltd., Long Beach, California

Believe it or not folks, but here is one of the things that keeps Mr. Ripley on the newspaper payrolls.

It started with a high resistance short on a certain line, which when traced to one of the stations, proved to be in the deskstand. The troubleman being unable to clear the trouble, replaced the deskstand and turned it in to the repair shop with a trouble ticket attached marked "WET."



View of switch-hook showing how the ants perished after coming in contact with current.

Neither the cords nor the inner base of the instrument showed any signs of moisture, so the repairman proceeded to dismantle it to gain access to the switch-hook assembly, wondering at the time how moisture could get to the switch-hook without the rest of the instrument showing signs of having been wet.

I believe his first remark upon observing the switch-hook was—"Quick, Henry, the Flit," for there, clinging in a large cluster on the contacts and smashed between the springs was a colony of red ants. But sad as it may seem, they were dead, victims of their own curiosity. They had imbibed too freely of the juice that passed through the contacts, which was too strong for their delicate constitutions. But how were they to know?

The ants had evidently crawled up the cord into the base and from there up the transmitter wires to the switch-hook where they no doubt experienced somewhat the same effect that you or I would were we to crawl into a bunch of high tension wires. Their bodies were burned to almost a hard crisp and fused together as though they had been mixed up in a good grade of glue.

Acknowledgement is made to Sergeant W. L. Woodruff, Finger Print Expert of the Long Beach Police Department, for his aid in securing the accompanying picture.

TELEPHONE CROSS-TALK

The Jamestown Telephone corporation located in one of the very best cities in the state of New York, has employed a "columnist", bought a column of space in the Jamestown Morning Post each Saturday and the editor of that column, Eunice Varley Carlson, began her gossip column recently.

In a statement the editor of the column says among other things: "The column has been engaged by the Jamestown Telephone corporation solely for the purpose of advertising its business; selling its service to the public; building up and retaining the good will of the community."

The column is filled with newsy paragraphs, written in a manner that will attract attention and hold the interest of the public.

The telephone company is spending money wisely in this instance. It is laying the foundation for further entrenching the company in the good graces of the community. It is our opinion that fewer rate reduction cases would now be found if this course had been pursued in the past.

MILWAUKEE SCHOOL USES STROMBERG EQUIPMENT

North Division High School of Milwaukee, Wis., has just contracted with the Stromberg-Carlson Telephone Manufacturing company for a single channel, No. 2 Program Service system. The system will include amplifying equipment, microphones, phonograph and radio, and 65 loud speakers.

ASK CHARITY FUNDS BE CHARGED AS EXPENSES

The New York Telephone company has asked that it be permitted to charge the contributions made by that company to Emergency Unemployment Relief to expenses. The New York Telephone company last winter contributed $75,000 to this fund.

The Interstate Commerce commission takes the position that all such contributions should be charged to the surplus of the company and not to operating expenses.

A hearing is scheduled upon this matter for May 19th in Washington, and it is understood that the United States Independent Telephone association will intercede for the telephone company, as the outcome of this decision will be considered as setting a precedent for other companies. The case will be watched with interest.

TELEPHONE MAN HEADS NEW COMPANY

Organization of the National Telephone and Telepost company, with headquarters in Lima, Ohio, was announced recently. The new company, headed by George B. Quatman, general manager of the Lima Telephone and Telegraph company, has inauagurated a public telegraph service between Chicago and Pittsburgh.

Between Toledo, Detroit and Chicago, the new concern will use the wires bought early this year at a receiver's sale from the International Telepost company of Chicago. Leased lines of the American Telephone and Telegraph company, will be used between Toledo, Cleveland, and Pittsburgh.

Automatic printers will be used for long distance messages and telegraph instruments will be operated for the messages between adjoining cities in the hookup.

Employees of the Lima Telephone and Telegraph company will perform most of the work incidental to placing the system in operation, and for its maintenance. Guy W. Brentlinger, Lima plant equipment superintendent, is supervising work at the Chicago terminal of the new company.

"UNIQUE"

THE BETTER TORCH
FOR USE
IN COLD WINDY WEATHER

Starts in 3 minutes.
Powerful flame—2000° F.
Fitted with Orifice cleaner.
Tank of 18 gauge steel.
Cool valve wheel—always.
Easily cleaned and serviced.

Try one for 30 days

Unique Mfg. Co., Inc.
221 WHITING ST. CHICAGO, ILL.

SAFETY DEPOSIT POWER

ALL THE OUTPUT GOES IN THE LINE

Whenever—wherever you hook up a Storm King Duro Power Telephone Battery you start with 100 per cent of the current locked in.

Shelf deterioration before and after installation is prevented by the patented top seal that stops evaporation and all useless losses. Electrocouples and corrosion are prevented by the one-piece seamless zinc cup, uniform in thickness and free from solder.

Tap the terminals with the assurance that the only way for the current to get out is in the line. Quick recuperation maintains potential. Safety deposit construction guarantees the actual delivery of all the current that we put in at the plant—third largest in the world.

General Dry Batteries
INCORPORATED
CLEVELAND, O.

General Dry Batteries of Canada, Ltd., Toronto, Canada

Telephone Activities in Foreign Countries

Dispatches from Abroad Keep Telephone Men in United States Constantly Informed Concerning Telephony of the World; Domestic Telephone Problems Oftentimes Can Be at Least Partially Solved by Watching the Outcome of Experiments Made Elsewhere

Operations of Swedish Telephone and Telegraph Service

The number of inland telegrams during the first 10 months of 1931 amounted to 2,185,778, a decrease of 3.6 per cent in comparison with the same period during 1930. The total number of long distance calls during January-October, 1931, was 23,157,011 and outgoing foreign calls 1,987,925 during the same period, an increase of 3.3 per cent and 6.5 per cent respectively, as compared with the corresponding period in 1930. The volume of business done during the first 10 months of 1931 by the Swedish telephone and telegraph service showed an increase of 2.4 per cent over the corresponding period in 1930. The net earnings for the first 10 months of 1931 amounted to 20,403,460 kroner (one krona equals $0.2680 at par), a decrease of 2.6 per cent as compared with the same period in 1930.

Italian Postal and State Telephones Increase Earnings

In the press of February 26, 1932, it was announced that both the Italian postal administration, which also conducts the telegraph service, and the State telephones showed a combined increase of 28,010,130 lire ($1,473,000) in net earnings for the fiscal year ended June 30, 1931, over 1929-30. Total receipts from the postal and telegraph services declined in 1930-31 by about 8,000,000 lire ($421,000) below their amount recorded in the preceding year, due to diminished earnings of parcels post and telegraph services. Savings in operation more than offset those smaller receipts. Accordingly, the net earnings of posts and telegraphs amounted in 1930-31 to 149,385,211 lire ($7,858,000), against 122,650,708 lire ($6,45,000) the year before. The State telephones mostly long-distance, showed in 1930-31, compared with the preceding year, increases in receipts of 9,451,733 lire ($497,000) and in expenses of 8,034,370 lire ($423,000). Net earnings from the telephone service amounted to 17,444,431 ($918,000), compared with 16,168,804 lire ($850,000) in 1929-30.

Argentine Telephone Connected With Hawaiian Islands

On March 1, 1932, the first direct telephone connection with the Hawaiian Islands was established between the Union Telefonica of Buenos Aires and the Mutual Telephone company of Hawaii. Hawaiian subscribers were reached from Buenos Aires via the short wave circuit to New York, thence by transcontinental line to California and by radio telephone to Hawaii.

Co-operation Between French and Swedish Companies

An agreement was concluded recently between the French subsidiary of the L. M. Ericsson Telephone company, Stockholm, and Etablissements Grammont, Paris, France, with a view to close co-operation between these two telephone companies in the French market. No exchange of stock will take place and the agreement is only for safeguarding the mutual interests of the two companies. The French concern is not so large as the French subsidiary of the L. M. Ericsson company but it employs about 400 workers. It uses the American so-called Rotary system, which is the same system that was adopted by the French Government for the automatization of the Paris telephone system. Even L. M. Ericsson has participated to a great extent in the automatization of the Paris system and is using the Rotary system in co-operation with the American interests.

Open New Line Between Sweden and Poland

Warsaw has been added to the list of foreign cities with which Stockholm has telephone connections. The Stockholm-Berlin section of this line is laid in cable and the balance consists of aerial lines with amplifiers in Posen. The entire line is about 1,000 miles in length. Calls in Sweden are limited to Stockholm, and in Poland to Warsaw and Gdynia, owing to the crowding of the lines. Sweden now has telephone connections, direct and indirect, with 53 foreign countries.

Telephone Popular in Swedish Leather Industry

Due to the very low rates on telephone calls in Sweden, the number of transactions in the leather industry consummated through the use of the telephone is tremendous. According to Stockholm leather dealers, the telephone replaces traveling salesmen to a very large extent. For instance, the cost of telephoning from Stockholm to Orebro, a distance of about 110 miles, is 10 cents for 3 minutes and from Stockholm to Goteberg, a distance of about 225 miles, 18 cents for 3 minutes. When a leather importer is well acquainted with and has the confidence of the leather buyer of a domestic shoe factory, the majority of his sales are consummated over the telephone.

Install Direct Calcutta-Bombay Telephone Circuit

At present communication in India between Bombay and Calcutta is via Delhi, but it is hoped that a direct circuit now being installed by Standard Telephones & Cables, Ltd., in conjunction with the department of Posts and Telegraphs will be in operation by the end of the financial year. The new circuit is of the high-frequency carrier type, with four repeater stations, and it serves for both telephony and telegraphy. A parallel stand-by sircuit is being provided, which will normally be used for intermediate service.

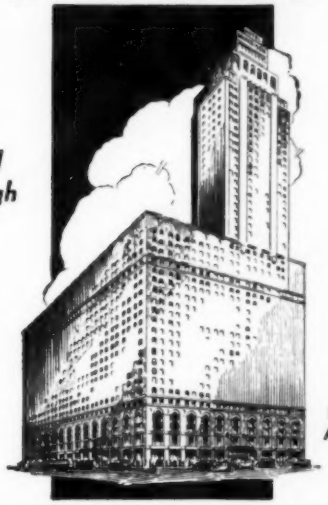
Swiss Telephone Subscribers Get New Service

All telephone subscribers in Switzerland having automatic dials (the majority of those in use), will have a new form of service offered them, beginning with summer, 1932. For an annual fee of 5 francs ($1) the following notation will be appended to their name, address, and telephone number in the directory: "When no reply call No. 11." If the caller wishes a message delivered, or wants information as to the whereabouts or time of return of the person called, he can apply for such service to "No. 11" which is the telephone administration's information bureau.

Leningrad Telephone Factory Increases Output

The annual program of the "Krasnaya Zarya" automatic telephone apparatus factory in Leningrad, Russia, which called for production in 1931 valued at 45,000,000 rubles ($23,170,000), was fulfilled on December 13, 1931. This plant was one of the first to fulfill its five-year plan in 2½ years. Its annual program for increasing labor productivity was carried out fully, while production costs were reduced 13.4 per cent, also fulfilling the plan.

IN CHICAGO



World's Tallest Hotel 46 Stories High

LEONARD HICKS
Managing Director

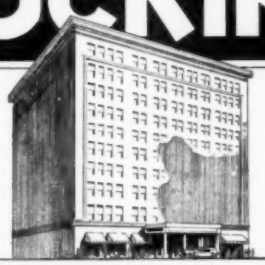
The extra attention given to the needs of guests will favorably impress you. Nearest to stores, offices, theatres and railroad stations. Each guest room is outside with bath, circulating ice water, bed-head reading lamp and Servidor. Housekeeper on each floor. Garage facilities.

2500 ROOMS $3.00 UP

MORRISON HOTEL

Madison and Clark Streets CHICAGO

HUCKINS



450 ROOMS 300 BATHS

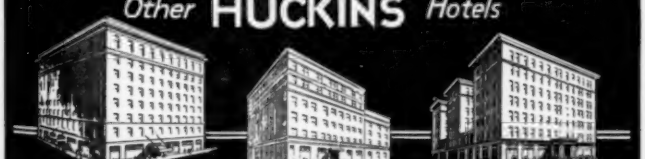
RATES FROM $2.

OKLAHOMA CITY

A Great Hotel in a Great City...Every modern convenience...Special floor for Ladies...Large parlor floor and Ladies' Lounge...New "Dungeon" Dining Room... Also Coffee Shop...Large and small Banquet rooms and beautiful new Ball Room for meetings

JOSEPH HUCKINS JR.
MANAGING DIRECTOR

Other HUCKINS *Hotels*



KEMP HOTEL WICHITA FALLS, TEXAS

OXFORD HOTEL ENID, OKLA.

WESTBROOK HOTEL FORT WORTH, TEXAS

The FLEXIBLE Four-Wheel Drive

IN THE RIVER OR ON THE CITY STREET . . . .

Performance and economy are combined in FWD trucks. The flexible four-wheel traction of the FWD enables it to do the ordinary trucking with ease and handle the so-called "hard hauls" with very little extra effort. The FWD does not develop more power than the ordinary type truck, but it puts more of the power developed to moving the load. The speed with which the truck does the work results in saving of time and labor.

The FWD drives through both front and rear wheels. The device which divides the power is the FWD center differential located in the transmission. When the traction is greater on one axle than on the other, it is only necessary to engage the differential lock, which is operated from the driver's seat, to give positive drive to both front and rear axles,—a center differential is necessary in order to compensate for the difference in distance travelled by the front and rear wheels in rounding corners and going over uneven ground.

Send back the coupon for further details.

THE FOUR WHEEL DRIVE AUTO CO.
CLINTONVILLE, WISCONSIN
CANADIAN FACTORY, KITCHENER, ONTARIO

FWD

International Standard Electric Corporation
67 Broad Street New York, U. S. A.

Kindly send me copy of exhaustive tests made by Purdue University which show the FWD Truck to be 88.2% efficient.

Name .....

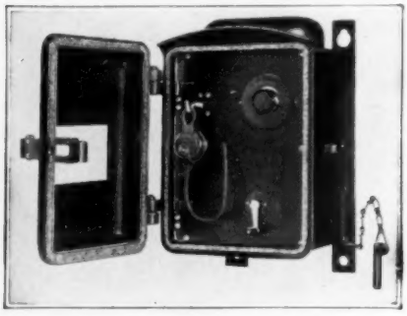
Address .....

Perfect Outdoor Telephone

New Outdoor Telephone, Weatherproof, and Ventilated to Prevent Condensation of Moisture, Is Introduced by Kellogg

A new outdoor telephone, possessing many unusual features of interest to railroads, mines, oil companies, lumber companies and similar industries that require a weatherproof telephone, has recently been placed on the market by the Kellogg Switchboard and Supply company of Chicago.

The Kellogg outdoor telephone is one of the latest developments in this field and is the finest unit of its kind. The perfection of this set is the culmination of a long study of the needs of many diversified industries who use outdoor



New outdoor telephone recently placed on the market by the Kellogg Switchboard & Supply Co.

telephones. Working in conjunction with engineers from many different companies, Kellogg engineers obtained suggestions and ideas as to what features the new set should incorporate. The final designs resulted in a telephone that possesses every desirable feature necessary to meet any communication requirement. As outdoor telephones are often used on long, heavily loaded lines where transmission and ringing efficiency are all important, provisions have been made to permit any circuit arrangement necessary to assure the highest quality of transmission and reception, and efficient ringing.

The cast iron housing is weatherproof and ventilated to prevent condensation of moisture or "sweating." All parts subject to damage by moisture are treated to withstand outdoor conditions. Iron and steel parts are protected by special moisture-proof finishes. All wires are rubber insulated, and coils are specially treated to resist moisture. The set has a cast-in shelf upon which three dry batteries may be placed. Ample space is provided for either the standard Kellogg five-bar or six-bar generator. This generator is mounted on a sliding Bakelite shelf and can easily be removed for inspection. The induction coil is mounted on another sliding Bakelite shelf upon which space is also available for a condenser when specified. The connecting rack is mounted on the induction coil. Simplified wiring with rubber insulated wire is used throughout. There is no cabling. The door of the iron housing is securely fastened by a locking pin which is attached to the box by a chain. The door swings to the left permitting free use of the right hand for the operation of the generator crank and other functions. There is ample space for all equipment. All parts are easily accessible, yet the set is reasonable in size and weight. Slotted screw holes in the mounting straps permit the setting of the upper lag screws before the housing is hung in place. The entire telephone may be easily handled and installed by one man.

Details of Equipment

Transmitter—No. 32-L low resistance local battery type for operation on either two or three standard or No. 6 dry cells. (Three dry cells are recommended for extremely long lines.)

Receiver—No. 81-A high efficiency watch-case type with cobalt steel magnet. Kellite cap brass shell finished in baked black enamel. This receiver was chosen because of the small space required without sacrificing quality of reception. Hand receivers cannot be furnished with this set.

Induction Coil—No. 100-A silicon steel core, balanced for transmission and reception. Includes Bakelite connecting rack, specially treated heads.

Ringer—No. 55-EG three-inch gongs—non-adjustable armature type—adjustable gong posts. (Probably the most efficient bell ever furnished in an outdoor telephone.)

Generator—No. 81 five-bar or No. 75 six-bar. Rust-proofed magnets. Impregnated armature. Brass end plates and bearings.

DISCUSS RATE PROBLEM AT DAKOTA CONVENTION

The rate problem was discussed by President H. M. Schumacher of Alexandria, S. D., at the annual South Dakota Telephone Association convention held at Sioux Falls, April 6 and 7.

"The rate question is especially aggravating at this time," he said. "Experience has shown that the lowering of rates will not keep a telephone in service. Rates once lowered are difficult to raise again. The solving of this problem requires careful handling.

"Rates for telephone service should be high enough to pay reasonable returns on the money invested in order to make this telephone business possible, to pay salaries and taxes, to lay away a certain amount each year to rebuild the telephone plant as it becomes worn out, and to keep the plant in good serviceable condition so that the highest class of telephone service can be furnished.

"Companies that have had inquiries in regard to requests for service rate reductions advise they have been best able to meet this problem by interviewing their customers. Generally a frank discussion of our business, together with an explanation of why the cost of furnishing telephone service has not come down, will clear up any questions the customer may have in regard to this subject. Misunderstandings are usually the result of lack of knowledge, and consequently, appreciation of others' problems.

"All public service companies should derive comfort from a ruling recently made by the Alabama Public Service commission. The commission declared that utility companies cannot lawfully be compelled to reduce their rates because general commodity prices are at an unusually low mark."

Mr. Schumacher was re-elected president at the convention. Other officers reelected are: F. R. Irons, of Woonsocket, vice-president; P. F. Orcutt, of Custer, vice-president; and Thomas Phalen, of Aberdeen, secretary-treasurer.

F. H. McGinnis, of Aberdeen, was the only new member elected to the board of directors. The other directors are: Charles E. Adams, Groton; D. T. Patterson, Sioux Falls; W. W. Straight, Crooks; F. R. Irons, Woonsocket; Ira S. Burnett, Armour; Grant E. Preston, Hitchcock; P. F. Oscutt. Custer; and H. M. Schumacher, Alexandria.

One of the features of the convention's two-day program was a demonstration of recent communication developments by Sergius P. Grace, of New York City, assistant vice-president of the Bell Telephone Laboratories, Inc.

Subscribers to the Lincoln Telephone & Telegraph company in the various Nebraska exchanges, will be given the privilege of paying for their telephone rental and toll service once a month, rather than every three months, if they so desire. Under this new arrangement, subscribers paying for the telephone on or before the tenth of each month will be given a 25 per cent discount from their bills.

COOK CABLE TERMINALS

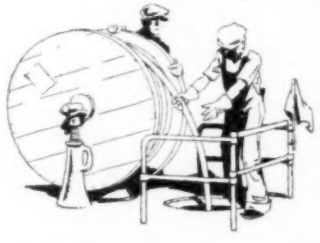
for AERIAL—UNDERGROUND and GAS FILLED CABLE

PROTECTED, UNPROTECTED OR CROSS CONNECTING

30 years of experience in designing and building equipment for terminating, distributing and protecting lead covered telephone cable is at your disposal.

COOK ELECTRIC COMPANY

2700 Southport Ave., Chicago



WIRES and CABLES

FOR any type of wire or cable used in Telephone, Telegraph or Power work—get in touch with "Phillips".

This company can supply you with any size, any grade or any type of wire or cable, either bare or insulated to suit your requirements.

Besides this you have the cooperation of a staff of experts in wire and cable manufacture, trained to value quality above all else—backed by a firm which has been in this one business for over forty years. Write for prices.

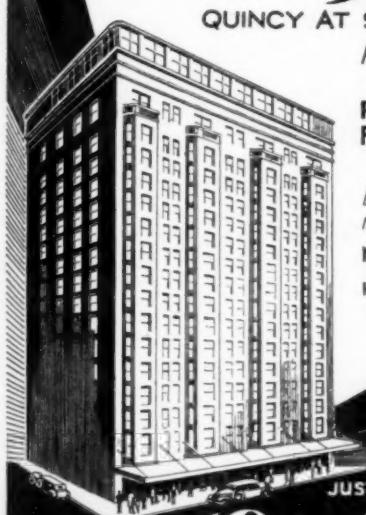
Since 1889 manufacturers of—
Bare and Insulated Copper Wires—Rubber Insulated Wires—Enameled Wire—Magnet Wire—Power Cables—Switchboard Cables —Paper Insulated Cables—Flexible Cords —Electrolytic Copper Rods, Shapes, etc.

EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD.

ESTABLISHED 1889
MONTREAL, CANADA

FACTORIES—MONTREAL AND BROCKVILLE
BRANCHES—WINNIPEG, TORONTO REGINA AND VANCOUVER
Distributors for British Columbia: Canadian Telephones & Supplies Limited, Vancouver

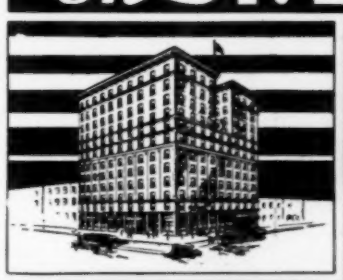
STOP IN THE LOOP
HOTEL
Majestic
QUINCY AT STATE STREET



Accommodations of exceptional value
ROOMS WITH PRIVATE BATH FROM $2.
Beautiful meeting room for 300 people
NEW GARAGE NEXT DOOR
HARRY F. HERMANSEN
Manager

JUST AROUND THE CORNER FROM EVERYTHING
in... Chicago

In ST. LOUIS



The AMERICAN HOTEL
275 ROOMS WITH BATH
$2.00 up

The ANNEX
226 ROOMS WITH BATH
$1.50 Up

The AMERICAN HOTEL
MARKET AT SEVENTH

The AMERICAN ANNEX
MARKET AT SIXTH

Our Food has made our Reputation
COFFEE SHOP OPEN UNTIL MIDNIGHT

OPTIMISM, CONFIDENCE REIGN AT STROMBERG-CARLSON CONFERENCE

Optimism and confidence in future radio and telephone business reigned at the two-day 1932 Annual Sales Conference of the Stromberg-Carlson Telephone Manufacturing company, May 6 and 7, at its plant in Rochester, New York.

Radio sales representatives reported that a decided trend toward quality radio on the part of dealers and the public was evident throughout the country.

Telephone men brought out that scores of telephone operating companies are carrying on employee sales campaigns which are greatly stimulating new business and aiding in regaining subscribers that have concelled telephone service.

These reports were heralded as sure indications that business was continuing on an upward swing. The conference was one of the most spirited held in years. New merchandising plans and sales policies were outlined and discussed at the two-day session.

A special sales conference will be held in San Francisco for sales representatives in the west coast territory. It will be under the direction of F. K. Cannon, Pacific Coast manager.

The first day of the Rochester Convention was given over to radio.

W. Roy McCanne, President and General Manager, opened the meeting by welcoming the salesmen to Rochester.

Ray H. Manson, vice-president and chief engineer, spoke on "Engineering Developments in Radio During the Past Year".

"Policy Administration" was the subject of an address given by George A. Scoville, vice president and sales manager.

Following Mr. Scoville, Harry A. Beach, radio sales manager, discussed "Vital Elements in Present Day Merchandising".

Benjamin Gross, president of Gross-Brennan, Inc., Stromberg-Carlson's New York representatives, spoke on "Selling Radio Equipment".

On Saturday morning "Telektor Remote Control Radio" was discussed by Lee McCanne, radio engineer, and E. A. Reinke, commercial sales manager, spoke on "Selling Program Service Equipment".

Jack Knabb, Lyddon, Hanford and Frohman, Inc., Rochester Advertising Agency, discussed "Revenue Builders Plan for 1932", a sales and advertising campaign designed to help telephone operating companies to increase their revenues.

"Selling Telephone Equipment and Supplies" was the subject of a talk given by B. Woodbury, telephone sales manager.

Those attending the conference in addition to the management and members of the sales organization in Rochester were: Rochester territory: J. T. Barrett, J. E. Finley, F. H. Anibal, C. W. Watson, C. E. Heston, L. A. Randall, F. Howard Waite, R. Davis, C. J. Hunt, G. E. Davis, A. B. Crawford and C. D. Kinne. Chicago territory: C. W. Schafer, H. T. McCaig, C. F. Sanders, M. W. Redmond, G. J. Johnson, W. H. Pride, C. A. Carlson, W. C. Caldwell, J. D. Kratz, R. H. Merriman, W. J. Pfeander, J. R. Thompson, J. A. Frye, A. C. Barg, J. J. Gilhooley, C. J. Tresslar and P. D. Myers. Kansas City territory: A. J. Roberts, A. B. Preble, K. G. Gillespie, P. Winemiller, J. P. Galligan, C. A. Sweet, T. C. Thompson, C. E. Phillips and O. C. McCanne. Canada: N. W. Baldwin, J. W. McNair, J. A. Berger, L. E. LaFleur, H. L. Fallis, F. L. Grout, J. C. Mackay and A. S. McPhail. Gross-Brennan, Inc., Stromberg-Carlson New York and New England representatives: Benjamin Gross, L. L. Spencer, W. I. Brunner, R. J. Cashman, W. L. Collins, F. McCloskey, J. A. Prestele, M. P. Fitzpatrick, P. B. Collison, C. G. Erickson and L. A. de Marrais, Frederick Cook and O. Wells.

"AS ONE SCOT TO ANOTHER"

The following letter reached us through our friend P. Kerr Higgins of St. Louis, and we reproduce part of it because of the historical points brought out:

Istanbul Telefon Turk Anonim Sirketi
Istanbul, Turkey, April 4, 1932.

Mr. P. Kerr Higgins Esqp.,
The Scotia Telephone Co.,
St. Louis, Mo.

My dear Peter:

It was a breath from old times when I saw your warlike photograph in the TELEPHONE ENGINEER, for March. It is not the first time I have noticed your name figuring in this or some other American Telephone Publication, but it is the first time I have seen you in the kilt. The photograph must either have been taken some years ago or else you are preserving your youth better a great deal than I am, as you will see from the enclosed passport photograph.

It is a long time now since we were in the same service in the old N. T. C. in Glasgow, but I am very pleased to gather from the TELEPHONE ENGINEER, that you have made good. Apparently you have been associated more with the Independent than with the Bell interests.

[One paragraph omitted referred to a number of friends of the two gentlemen and probably unknown to the others of our readers.]

I came out here in January 1913, immediately after the transfer of the British system to the Government and have been here ever since, except during the war. I managed to get home early in 1915, after being in a Turkish gaol, but came back immediately after the Armistice. The Constantinople Company has had a very unfortunate career. War after war has dislocated business, culminating in the Great War, and now, when Europe is nominally at peace, the bottom has fallen out of business altogether and we are losing subscribers in shoals.

I suppose you are now an American citizen, in spite of the kilt.

Yours very sincerely,
F. DOUGLAS-WATSON.

UTILITIES MUST TELL THEIR SIDE

Public utilities have allowed their battle with politicians to be one-sided long enough, according to Alex F. Osborn, vice-president, Batten, Barton, Durstine & Osborn, Inc. No other business, he points out in a recent issue of Printers' Ink, seems to be attacked as often or as fiercely as public utilities. Why have they been considered such easy prey by the politician who seeks to make capital out of the conflict?

"Isn't it true," Mr. Osborn says, "that few people understand anything at all about utility economics? This public ignorance is what makes the subject an amazingly fertile issue for the politician. He has only to mix a few half truths with a liberal dose of fear and prejudice and there it is on the front page."

ILLINOIS COMMERCIAL BUYS TWO COMPANIES

Purchase of two telephone companies, one in Madison county and the other in Macoupin county, by the Illinois Commercial Telephone company, for $150,000 has been authorized in an order issued by the Illinois Commerce commission.

The companies sold were the Highland Telephone company, Highland, Madison county, and the Inter-County Telephone company, Mt. Olive, Macoupin county. The purchase price of $150,000 was free of liens on encumbrances excepting liabilities of $39,960, to be paid by the purchasing company.

The commission also granted the purchasing company authority to issue and sell 2,521 shares of its $6 cumulative preferred capital stock without par value. Present rates of the companies absorbed will be maintained, the order stated.

With Manufacturers and Jobbers

FWD PRESIDENT MAKES NATIONAL SURVEY

"The greatest requisite for individual success, or success of a company," stated W. A. Olen, president of the Four Wheel Drive Auto company, in a recent address to members of his organization, "depends upon having an optimistic view, and having that optimism based on facts." Mr. Olen had just returned from a trip through Eastern Canada and the Eastern and Southern states. During the seven weeks he was on the road he covered twenty-seven states for the purpose of getting first hand information regarding business conditions and markets.

He reported that his branches and dealers, no matter where he went, had more prospects than they were able to handle. The buyers, however, were more cautious in their buying and very careful from whom they selected their goods. "They are paying more attention," said Mr. Olen, "to the organization back of the product, and are analyzing the companies producing the goods they are considering, much more seriously than they ever have before."

Mr. Olen plans shortly to make a trip through the Western part of the United States, and when this trip is completed he will have observed conditions in forty-two states in the union.

Another interesting observation made by Mr. Olen was that it is now necessary to have bigger men selling, for it is the bigger men who are doing the buying. Purchasing by large corporations is not relegated to subordinates, but is handled by the top executives, who are, of necessity, vitally concerned about the expenditures of the corporations which they manage. It is obviously necessary that whoever attempts to sell these men must also be of high calibre and well versed in his product and have a good working knowledge of its application, not only to the prospect's market which the salesman is selling, but to the individual requirements of the prospect upon which he is calling.

Mr. Olen likened the depression to a storm on the sea, and his company to a ship going through that storm. "It is necessary," he said, "to slow up at times in order to effectively battle with the winds and waves. All of the crew should be on the job at all times and respond to the leadership of the management, for only through concerted effort on the part of the organization will the ship continue safely through the troubled waters."

KELLOGG SWITCHBOARD FOR SHELDAHL

The Sheldahl Telephone company of Sheldahl, Iowa, purchased a No. 150-A magneto switchboard from Kellogg Switchboard and Supply company last month.

The new equipment was purchased to assure subscribers more modern and more efficient service. At present about 105 subscribers are being served. The new Kellogg switchboard is wired for 100 lines and equipped with 45. It is wired for 15 cords and equipped with ten. R. L. Thomas, Kellogg representative, through whom the board was purchased, plans to supervise the installation of the equipment and acquaint the operators with it, when the company is ready. Fred Craft, secretary of the Sheldahl Telephone company, says that the board is to be installed early next month.

N. E. BIGLEY JOINS KEARNEY CORPORATION

The James R. Kearney corporation is pleased to announce that N. E. Bigley has been appointed as its special representative in the Chicago territory.

Mr. Bigley will be remembered from his past connection as a representative and estimator with the Crouse Hinds company. His most recent connection, however, was with the Erie Malleable Iron company as representative of the Chicago branch office.

SCOTIA COMPANY BUYS STROMBERG EQUIPMENT

The Scotia Telephone company of St. Louis, Mo., has contracted with the Stromberg-Carlson Telephone company for four sections of its No. 13 unit type switchboard for its Union, Mo., Exchange. The new board will be equipped with 310 central energy and 50 rural and toll lines. It will be complete with terminal power and machine equipment.

COLUMBIA COMPANY BUYS KELLOGG SWITCHBOARD

The Columbia Telephone company, with headquarters at Columbia, Pa., recently completed another portion of its improvement program by purchasing a new 6-800 Masterbuilt switchboard from the Kellogg Switchboard and Supply company, Chicago. The new switchboard is to be installed in the Mount Joy exchange, one of the three exchanges that the company operates in Lancaster county, Pa. Some 2,150 magneto subscribers and 1,750 common battery subscribers are being served through the Columbia Telephone company's system.

Mount Joy is a thriving agricultural and industrial town that is growing rapidly. And because of this rapid growth, the Columbia Telephone company selected and purchased a Masterbuilt switchboard. The Mount Joy exchange is also experiencing a substantial growth in toll traffic, which is another reason for the choice of Masterbuilt equipment. As growth continues, and changes or additions are required in the positional units of the new switchboard, such changes or additions can be made quickly and easily without excessive costs or interruption of daytime service. These and other Masterbuilt flexibility features assure the telephone company a safe investment in equipment that will always be modern.

The new 3-position 6-800 Masterbuilt switchboard for Mount Joy is wired and equipped for 300 Universal local lines, 20 magneto rural lines, and forty toll lines.

H. A. Oberdorf, president of the company, plans to have the new Masterbuilt switchboard cut into service early in 1932.

STROMBERG-CARLSON MOVES CHICAGO OFFICES

The Stromberg-Carlson Telephone Manufacturing company, with factory and general offices in Rochester, N. Y., recently moved its Chicago branch to 564-570 West Adams street. Offices and sales rooms were formerly located at 17 South Jefferson street, Chicago.

"SPLIT" PROGRAMS OFFER POSSIBILITIES

During the Westinghouse radio hour, Sunday, March 27, the first successful "split" program was transmitted. Ralph Leavenworth, general advertising manager of the Westinghouse Electric & Manufacturing company, spoke in English about the famous disc thermostat via KDKA, while at the same time in another studio, Senor Francisco Ortiga made an address in Spanish over the short wave of W8XK. This unusual program is the beginning of a series arranged for English and Spanish listeners.

The musical part of the program was simultaneously transmitted from both the long broadcast-wave of KDKA and the short wave of W8XK, as is usually done with ordinary station programs. However, when reaching the spoken part of the program, which was to be "split," it required a quick switch in studio lines and some technical changes in the wire connections linking the microphones with the long and short wave transmitting apparatus.

The "split" program, possibly where only long and short wave stations are available, offer many new possibilities in broadcasting so far undeveloped.

POSITION WANTED: By young married man with ten years experience in all plant work including cable splicing. Can furnish good references and will go any place. G. F., c/o Tel. Eng.

SITUATION WANTED: Telephone man with eleven years experience would like to hear of available position as trouble-shooter, lineman or manager. Married and has three children. Can furnish bond and good reference. Write A. G., c/o Tel. Eng.

J. G. WRAY & CO.
Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies
J. G. Wray, Fellow A. I. E. E.
Cyrus G. Hill
Rm. 2130 Bankers Bldg., Chicago

REBUILT
Telephone Apparatus and Exchange Equipment Saves You 30 to 50 Per Cent—Without Sacrificing Quality or Efficiency in the Least.

WHY BECAUSE it is all up-to-date in design — of the best and most reputable manufacture — and is in most cases generally better than the majority of equipment you now have in service.

Our Stock Is Immense — Magneto or Common Battery — including Switchboards — Switchboard Apparatus — Telephones — Protection Equipment — Cable — everything you need for the installation of a new exchange or maintaining your present one.

Twenty Years Successful Operation of this Department in connection with our business puts it past the experimental state — Quality and Price have made our customers permanent — it will pay YOU to investigate.

Ask for Free Bulletin. Address
PREMIER ELECTRIC COMPANY
3800-3810 Ravenswood Ave., CHICAGO, ILL.
"Rebuilt" when connected with Premier means something.

RECONSTRUCTED EQUIPMENT

Western Elec. No. 25A or No. 76 repeating coils—2 coils mounted on one mounting block, per pair @	$ 5.25
Kellogg No. 101E 500 ohm combine line drops and jacks, 10 per strip @	11.50
Stromberg No. 11 combine line drops and jacks, per strip of 5 @	7.00
Holtzer-Cabot 110-volt A. C. Motor H. P. 1/8 Speed 1150 R. P. M. @	10.00
Kellogg No. 2812 Latest type 5-bar 1600 ohm Bdg. compacts @	10.50
Kellogg No. 84 desk set with No. 2361 5-bar 1600 ohm inside connection signal set @	11.75
Kellogg No. 301 Combine line drops and jacks, per strip of 5 @	7.50
Kellogg No. 97 C. B. desk set with Straight line No. 75 Steel bell box @	7.00
Cook No. 10 Arresters, per bank of 20 lines with heat coils @	8.50
Chicago Tel. Supply Co. 4-bar 1600 ohm Bdg. compacts @	6.25
Western Elec. No. 22 3-bar Generators with Crank & Screws @	1.50
Stromberg No. 104 type 4-bar 1600 ohm Bdg. compacts @	6.90
Automatic Elec. Receivers with cord and New W. E. Shell and Cap @	1.10
Monarch L. B. Ind. Coils, 4-clip type @	.35

Write for Bulletins

REBUILT ELECTRIC EQUIPMENT CO.
1940 West 21st Str., Pilsen Station Chicago, Ill.

COFFEY SYSTEM & AUDIT CO.
Exclusive telephone accounting since 1907.
Certified Public Accountants.
We install the well-known
COFFEY SYSTEM
Audits—Rate Cases and Special Work.
A Central Accounting Department.
454 Consolidated Bldg., Indianapolis, Ind.

Make Your Directory a Source of Income
Write for Particulars
J. H. WELKER
McKINLEY BLOCK, CANTON, O.
Telephone 8009
DIRECTORY ADVERTISING EXCLUSIVELY

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

of Telephone Engineer, published monthly at Chicago, Illinois, for April 1, 1932.

State of Illinois, County of Cook, ss.—Before me, a notary public in and for the State and county aforesaid, personally appeared J. A. Smith, who, having been duly sworn according to law, deposes and says that he is the business manager of the Telephone Engineer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Telephone Engineer Publishing Co., Chicago, Illinois.

Editor—E. D. Graff, Chicago, Illinois.

Business Manager—J. A. Smith, Chicago, Illinois.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address as well as those of each individual member must be given.

Telephone Engineer Pub. Co., Chicago, Ill.
Mrs. Florence J. Beyer, Chicago, Ill.
F. A. Bowdle, Cerro, Gordo, Ill.
P. Kerg Higgins, St. Louis, Mo.
Miss Dorothy Weiner, Chicago, Ill.
C. L. Jones, Athens, Ohio.
Agnes M. Leffert, Logansport, Ind.
F. O. Cuppy, Lafayette, Indiana.
J. A. Smith, Chicago, Ill.
John H. Wright, Jamestown, N. Y.
Mrs. J. A. Smith, Chicago, Ill.
Walter J. Uhl, Logansport, Ind.
Mrs. Walter J. Uhl, Logansport, Ind.

3. That the known bondholders, mortgagees, and other security holders owning or holding one per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.)

W. H. Graffis, Star City, Indiana.
Herb Graffis, Chicago, Ill.
Joe Graffis, Chicago.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

J. A. SMITH,
Business Manager.

Sworn to and subscribed before me this 29th day of March, 1932.

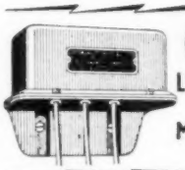
(Seal) H. W. SUREY,
Notary Public.

(My commission expires March 8, 1933.)

We will sell your
Telephone Directory ADVERTISING
or will publish your directory complete
L. M. BERRY & CO. DAYTON, OHIO

ACCOUNTING
HERDRICH AND BOGGS
Certified Public Accountants
Specializing in Telephone Accounting and Rate Cases Since 1918.
901-7 Continental Bank Bldg.
Indianapolis, Indiana

New STEWART Cable Tester
The only cable tester that will locate all kinds of water trouble. Tone will not carry by on armor of cable. Has tone circuit for tag splices.
Price $49.00
STEWART BROTHERS
OTTAWA, ILL.



CHAPMAN
LIGHTNING ARRESTERS
MADE BY
MINNESOTA ELECTRIC CO
MINNEAPOLIS, MINN.

Batteries
(Sealed glass jar type)
11 CELLS
Electric Storage Battery Co.
EMGO-9
(Practically new)
$7.50 each
Buckeye Telephone & Supply Company
Columbus, Ohio